# ECONOMIC ASSESSMENT OF WATER POLLUTION ABATEMENT OPTIONS FOR ONTARIO PULP AND PAPER MILLS

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NOTE:

This report and the data on which it is based represents the operation of 27 Ontario pulp and paper mills subject to MISA Regulation.

In October 1992, Abitibi-Price announced the permanent closure of one of its mills in Thunder Bay leaving twenty-six mills currently subject to MISA Regulation in Ontario.

## ABSTRACT

The cost-effectiveness and potential economic and financial effects of different levels of water pollution abatement identified were assessed in support of effluent limits development for Ontario pulp and paper mills. Implications of incremental abatement costs, the capacity of firms to pass on these costs as increased product prices and effects on the competitive position and financial performance of the sector as a whole and its constituent firms were assessed. The annualized capital and operating costs of the options analyzed in the report ranged up to 9% of direct manufacturing costs but could exacerbate poor financial results should financial performance similar to the early 1990s continue for the next several years. However, if future financial performance during the next decade mirror that of the average performance over the last 10 years, changes in measures of liquidity, solvency or profitability would range from little or no change for one option to a 27 % reduction in profit at another company for the highest cost option.

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# EXECUTIVE SUMMARY

## Purpose of this Report

The Municipal-Industrial Strategy for Abatement (MISA) program was announced in the White Paper issued in June 1986 and entitled **Municipal-Industrial Strategy for Abatement**. The Program is intended to achieve the "virtual elimination of toxic contaminants in municipal and industrial discharges into (Ontario's) waterways". Regulations have been promulgated that required intensive monitoring of industrial waste-water discharges. Further regulations are now being developed which will specify discharge limits for a wide range of contaminants.

For each MISA sector regulation that is developed, an economic assessment report is being prepared. The present Economic Assessment Report is intended to serve as a reference document of factual information and analytical results that can be used to evaluate specific limits proposals for Ontario pulp and paper mills.

Specific limits proposals are not evaluated in this report. Rather, the technology combinations, estimated contaminant reductions and associated costs analyzed in this report are illustrative and reflect technical possibilities rather than proposed or recommended effluent limits.

## Cost Analyses of BAT Options

A Best Available Technology (BAT) Option is a set of one or more demonstrated technologies at each plant that can achieve specific effluent concentration or loading levels. Five Best Available Technology (BAT) options or technology combinations have been identified for sulphate (kraft) pulping mills, four for deinking/board/fine papers/tissue mills while three BAT options have been defined for each of the sulphite-mechanical pulping and corrugating mills. Estimated potential least-cost/contaminant removal combinations were developed for each mill.

Numerous aggregate levels of abatement for each category and the sector as a whole can be constructed by combining BAT options at the 27 mills based on predefined decision rules. Two aggregate levels of abatement and associated costs were defined for each category and for the sector as a whole. The costs associated with these levels of abatement were used in subsequent financial analyses.

The first of these aggregate abatement scenarios represented the Most Cost Effective (MCE) Level of abatement. BAT Options were defined at each mill which represented the lowest average and incremental cost per kilogram of pollutants removed. Application of these technology combinations at each plant in

the sector could remove 28,100 tonnes per year of the initial loadings of TSS (36,300 tonnes per year), 113,000 tonnes per year of BOD recorded loadings (117,400 tonnes per year) and 2,700 tonnes per year of the AOX loadings (3,900 tonnes per year) from sulphate (kraft) mills at a capital cost of $583 million and an annual operating cost of $54 million.

The second aggregate option represented the Maximum Technically Achievable Removal (MAX) Level for the sector given available technology. Application of these technology combinations at each mill could reduce recorded TSS loadings by 31,400 tonnes per year, BOD loadings by 114,500 tonnes per year, and AOX loadings from the 9 sulphate (kraft) mills by 3,300 tonnes per year at a capital cost of $1.3 billion and an annual operating cost of $61 million.

Annualized costs and percentage reductions for each scenario are noted in the table below.

**COSTS AND REDUCTIONS**

| Option | Annualized Costs [1] (millions) | Percentage Reductions [2] | | |
|---|---|---|---|---|
| | | AOX | BOD | TSS |
| MCE | $94 | 70% | 96% | 77% |
| MAX | $181 | 85% | 98% | 86% |

Notes: [1] Capital and Operating Costs Annualized over 10 years at 12%
[2] Table does not specify actual limits

## Industry Trends and The Ability to Pass on Cost Increases

The 27 Ontario mills that are subject to MISA regulations produce outputs for 8 different product markets and employ over 17,000 people. The three primary product groups are newsprint, market pulp and fine papers. Each of these markets was analyzed to determine the ability of Ontario pulp and paper mills to pass through cost increases as higher prices.

About 65% of the market pulp produced by Ontario mills is exported to the U.S. each year. Similarly, most of Ontario's newsprint production is exported to the U.S. Exports of these two key products are facilitated by the absence of tariffs on wood pulp and newsprint in key customer nations: the United States and Britain.

Prices for market pulp are determined in international markets over which individual pulp producers have little control.

While newsprint remains the dominant product of the Ontario industry, newsprint production has been declining as a percentage of total Ontario paper production in the last 20 years. Ontario newsprint producers have been subject to increasing competition from U.S. and off-shore suppliers. Furthermore, the current economic recession and declining demand has forced Ontario mills to reduce capacity utilization rates. These market conditions limit the ability of Ontario mills to pass on abatement costs as price increases.

Historically, domestic markets for fine paper, tissue and corrugating products have been tariff protected and supplied by relatively few Canadian producers who could maintain prices well above cost levels. However, disappearing trade barriers have opened these producers to increasing competition and have eroded the ability of firms to effect price increases for most paper products. Diminishing trade barriers also open market opportunities to Canadian and Ontario producers and can ultimately permit Canadian firms to establish larger production runs and capture cost savings from economies of scale.

It is unlikely that individual Ontario firms can extract off-setting cost reductions from other input factors such as labour or raw materials.

**Financial Assessment of Regulatory Costs on Firms**

Financial impact analyses were undertaken on six pulp and paper companies which operate 14 mills in Ontario, and for which published financial data for the years 1981-1990 are available from Statistics Canada and consolidated financial reports of each firm.

For these firms, historical financial data were adjusted or "shocked" with the two levels of MISA-related abatement and monitoring costs to determine how each of 15 financial indicators would change from recorded data if the costs had been incurred during the relevant time period.

A second analysis incorporated estimated costs provided by four firms to meet announced environmental regulations in other Canadian jurisdictions in which they operate mills.

Financial assessments using only Ontario MISA-related costs indicate that, if future financial performance during the next decade mirror that of the average performance over the last 10 years, generally, minor differences occur in financial ratios when adjusted to reflect the cost of the MCE option and the MAX option. Changes in measures of liquidity, solvency or profitability would range from little or no change for some indicators at one firm as a result of costs associated with the MCE level, to a 27 % reduction in profit at another company for the Maximum Removal Level costs.

However, should poor financial performance similar to the early 1990s continue for the next several years, the imposition of either level of abatement would exacerbate poor financial results. The results of the analysis indicate that the MCE option would do much less than the MAX option to exacerbate current poor financial results among the firms analyzed.

Assuming debt financing, three of the six firms could have their debt to asset ratios pushed to record levels if they incurred costs of the Maximum Removal level. This consequence can be problematic to companies that find their ability to borrow funds already strained by current economic conditions.

**Implications for Competitiveness**

The competitive position of Ontario pulp and paper mills rests, in part, on the

U.S./Canadian dollar exchange rate. The value of Ontario shipments to the U.S. was approximately $2.2 billion in 1989. Assuming shipments remain constant and assuming an exchange rate of $1 Canadian = $0.87 U.S., the Canadian dollar would have to depreciate by 7% to $0.81 U.S. in order for the industry to accumulate funds equal to the proposed annualized costs associated with the Maximum Removal Option plus the MISA monitoring requirements.

On the other hand, an exchange rate depreciation of only 4% to $0.835 US (the US dollar would increase in value by less than 4 cents in relation to the Canadian dollar) would be necessary to generate extra revenue equal to the total annualized cost of the Most Cost Effective removal level of abatement. Between November 1991 and July 1992, the period of completing this report, the Canadian dollar has in fact depreciated below $0.835 cents from $0.870.

The added costs associated with the Most Cost Effective Level and the MISA monitoring requirements to production costs would not displace Eastern Canadian pulp mills from their current position as the third lowest cost producer as determined by the Forest Sector Advisory Council. If the Maximum Removal Option costs were incurred, Eastern Canadian market pulp producers would be pushed from their position as the third lowest cost producer to the highest cost producer among the regions examined (i.e. U.S. South, U.S. West, Eastern Canada, B.C. Coast, B.C. Interior, Finland and Sweden).

Neither aggregate level of abatement scenario would raise total operating costs of newsprint producers sufficiently to displace Canadian mills from their position as the second highest cost producers as identified by the Forest Sector Advisory Council, among the five nations and regions it compared (i.e. U.S. South, U.S. West, Sweden, Canada and Finland). However, the additional regulatory costs would widen the gap in production costs that currently exists between Canadian producers and their main competitor, American producers.

Proposed MISA costs would impact all components of direct manufacturing cost except wood fibre costs. The total annualized cost, which combines the annualized capital and annual operating costs, amounts to, at most, 9% of direct manufacturing costs for the Maximum Removal option (5% for the Most Cost Effective Option). At this level it represents the smallest cost category when compared to Materials and Supplies, Salary and Wages and Fuel and Electricity costs for the industry.

Claims are often made that stringent pollution control demands may induce Ontario mills to divert some capital investment from machinery and equipment to upgrade or modernize production process to systems and equipment for pollution control, thereby decreasing competitiveness.

However, competitiveness expert Michael Porter recently noted in his book, <u>The Competitive Advantage of Nations</u>,

*The conflict between environmental protection and economic competitiveness is a false dichotomy.*

Porter reports that nations with the most rigorous environmental requirements often are leaders in the export of products from the affected industries. According to Porter,

*Exacting standards seem at first blush to raise costs and make firms less competitive, particularly if competitors are from nations with fewer regulations. This may be true if everything stays the same except that expensive pollution-control equipment is added.*

*But everything will not stay the same. Properly constructed regulatory standards, which aim at outcomes and not methods, will encourage companies to re-engineer their technology. The result in many cases is a process that not only pollutes less but lowers costs or improves quality.*

In addition to the costs associated with MISA regulations, the pulp and paper industry will also have to invest capital, or incur higher operating costs, in Ontario to accommodate greater levels of timber management and regeneration, increasing post-consumer waste fibre content requirements for newsprint and emerging competition from off-shore producers as trade barriers fall. Any one of these issues by themselves might not have undue economic consequences for the industry however, taken together, they present the Ontario and Canadian pulp and paper industry with a challenge.

# 1.0 INTRODUCTION

*Twenty seven Ontario pulp and paper mills which discharge effluent directly to Ontario waterways are subject to Municipal-Industrial Strategy for Abatement (MISA) regulations. Economic and financial implications of potential water pollution abatement programs at these mills are to be assessed in this report. This Economic Assessment Report is intended to serve as a reference document of factual information as well as analytical results that can be used to evaluate proposed regulatory requirements for Ontario pulp and paper mills. The contaminants for which reductions are estimated in the report and the loading levels to which these contaminants may be reduced reflect technical possibilities rather than proposed or recommended effluent limits.*

## 1.1 The MISA Program

The MISA program was announced in a White Paper issued in June 1986 and entitled **Municipal-Industrial Strategy for Abatement**. The Program is intended to achieve the "virtual elimination of toxic contaminants in municipal and industrial discharges into (Ontario's) waterways". Regulations have been promulgated that required intensive monitoring of industrial waste-water discharges. Further regulations are now being developed which will specify discharge limits for a wide range of contaminants. These limits are to be determined according to the "Best Available Technology, Economically Achievable" (BATEA) to each industrial sector.

Estimates of the costs of the MISA monitoring requirements and their implications for the 27 Ontario Pulp and Paper Mills which are classified as direct dischargers are presented in one of a series of reports by the Ontario Ministry of the Environment (August 1989) which detail the costs of the MISA monitoring regulations and their economic implications for direct dischargers to surface waters of the province.

The analyses in this report follow principles and guidelines set out in the report, **Economic Information Needs and Assessments for Development of MISA Monitoring and Abatement Requirements** (Ontario, Ministry of the Environment, March 1987) and Chapter 6 of the <u>MISA Issues Resolution Committee Reports</u> (June 1990). Specific procedures, methodologies, assumptions and data utilized in these analyses have been developed by the Economic Assessment (EA) Subcommittee of the Pulp and Paper Joint Technical Committee.

## 1.2 Objectives of This Report

The primary objectives of the economic assessment of potential pollution abatement options are:

1) to evaluate the cost effectiveness of potential wastewater treatment and abatement program options;

2) to show the incremental costs of successively higher levels of contaminant removal (lower levels of pollutant loadings in wastewaters); and,

3) to assess the potential financial and economic consequences of costs associated with potential abatement program options that are cost effective plus other MISA-related costs that may be incurred by regulated plants.

The estimates and the results presented in this report do not, at this time, specify or imply what the effluent limits requirements for this sector are or will be. The present report is intended to serve as a reference document of factual information about the industry as well as analytical results that can be used in the development of a limits regulation for pulp and paper mills.

## 1.2 Structure of the Report

This report is divided into eight chapters. Chapter 2 presents the analytical procedures and issues explored in the report. Chapter 3 reviews the structure of the Canadian and Ontario pulp and paper industry, examining the history, market structure and forecasts for the primary products of the industry. Chapter 4 analyzes Best Available Technology (BAT) Options for cost-effectiveness. Chapter 5 examines the ability of the industry to pass through cost increases as price increases to their customers. Chapter 6 is a financial assessment of firms incurring the cost of specific BATs. Chapter 7 examines how potential MISA-related regulatory costs could influence the competitive circumstances facing Ontario pulp and paper mills. Chapter 8 is a summary of findings and Chapter 9 lists references used to write this report.

# 2.0 ANALYTICAL PROCEDURES AND ISSUES

*Derivation of "abatement cost functions" that compare the technologies and costs of achieving different degrees of contaminant reductions at each plant is the key tool for the analyses presented in this report. Input data and information used in developing cost functions were obtained from technical consultants and Ministry staff. The cost-effectiveness of different abatement technology combinations was compared by calculating the average and marginal costs per unit pollutant reduced. Representative abatement scenarios over all mills were defined in order to assess the implications of regulatory costs on company financial performance as well as on production costs. Effects on sector and firm-level competitiveness are also analyzed in this report.*

## 2.1 BAT Options, Abatement Cost Functions and Cost-Effectiveness

An abatement technology can be any device or system that will reduce pollutant concentrations or loadings, including best management practices, production process changes, input substitutions or flow reduction technologies.

In the MISA White paper, "Best Available Technology" refers to one or a combination of specific abatement technologies that may be installed in an existing plant. However, in most industrial plants, there are a wide range of technologies that can be combined to achieve different levels or degrees of contaminant removal. While the costs of implementing a technology can be based on certain standard features in an operation, mills vary in their site specific characteristics. Each mill will be different in terms of vintage, product mix, pulp making and paper making processes, capacity levels, and the mix of wood species used. These factors have a bearing on the choice of pollution control technologies to achieve reductions in water-borne pollutants.

An analysis of any industry must define a timeframe in order to present consistent and comparable data and assessments. Data on mill configuration, production and employment are representative of conditions prevailing through the end of the MISA monitoring period, e.g., January 1991. **Specific developments occurring in the industry since that time may not be reflected in the subsequent analyses.**

The draft MISA Issues Resolution Committee Report defines a "Best Available Technology Option" (**BAT Option**) as a set of one or more technologies or "technology trains" that can be applied to each mill to achieve a goal or set of objectives or constraints.

A range of BAT Options are to be defined for each regulated sector and the associated costs and contaminant removals associated at each plant are to be estimated.

Cost estimates and associated contaminant removals associated with each BAT Option are used to devise **Abatement Cost Functions**, the primary analytical tool used in the economic analyses to follow. Abatement cost functions show the costs of different technology combinations that can be applied to a given plant associated with successively higher levels of contaminant reduction (or lower levels of final loadings in the effluent). Where more than one combination of technologies will achieve the same level of contaminant removal at different costs, the **least cost** combination of technologies is used in the derivation of the cost functions. Determination of least-cost technology combinations or BAT options is a necessary prerequisite to any financial assessment of abatement costs on the regulated plants, firms or industry.

After technically "achievable", least-cost levels of abatement at each plant are identified, the next step is to ascertain those technically feasible technology trains that are most cost-effective according to the average cost per unit of pollutant removed.

Cost-Effectiveness analysis is a comparative economic tool used to assess different technical options to determine which is better. Alternative courses of action are contrasted in terms of their costs and effectiveness in attaining a specific objective (Weinstien, 1984). The objective in this analysis is the lowest cost per tonne of pollutant removed.

The lower the cost per kilogram of pollutant removed, the more cost-effective the option.

A more sensitive measure of cost-effectiveness is the average incremental cost for each additional unit of pollutant removed in achieving successively higher levels of contaminant reduction in the effluent. The lower the ratio of average incremental cost per incremental unit of pollutant removed, the more cost-effective the technology train or BAT Option.

These two measures of cost-effectiveness require estimates of the loadings (mass) of one or more pollutants removed in the denominator of the ratio. Differences of opinion exist regarding the suitability of aggregating different pollutants in order to compute the cost per unit of pollutant removed. These concerns will be discussed in Chapter 4.

**Aggregate abatement cost functions** can also be derived for each firm which operates more than one plant, for each category or the sector as a whole. Cost function tables or graphs show the total or incremental costs of specific degrees of contaminant removal for each plant in the sector, up to the maximum technically achievable level of abatement for the contaminant of concern.

## 2.2 Analytical Steps

The economic analyses presented in this report follow a standard work plan which is employed in all economic assessments of MISA regulated industrial sectors. The work plan consists of the following eight steps:

1. Define BAT Options and postulate technology combinations at each

mill that will achieve the BAT Option.

2. Compute cost-effectiveness measures of each BAT Option at each mill and each category for one or more types of pollutant removed with estimates of the program costs. In particular, generate cost functions that show the costs of increasingly stringent levels of pollution reduction and that identify where large cost increases yield little additional reductions in pollution loadings.

3. For each BAT Option, determine the distribution of costs and contaminant reductions among plants and firms.

4. Analyze the ability of the industry and its constituent firms to pass on potential regulatory costs as increased product prices or to reduce input expenses in order to offset abatement costs.

5. Assuming that **no** costs can be passed on as higher prices, evaluate the effects of estimated MISA-related costs on the past and future financial position of the aggregate sector, firms in the sector and individual plants or production units, to the extent that data are available.

6. Analyze effects on the competitive position of the regulated Ontario sector and its constituent firms as a result of the estimated potential regulatory-induced costs.

7. Where relevant, show the implications for small businesses that may be subject to the regulatory requirements.[1]

8. Address the issues peculiar to each industrial sector as identified by the JTC or its subcommittees.

As specified in the MISA Issues Resolution Committee Reports (June 1990), financial assessments of the implications of potential regulatory-induced costs will be carried out at the level of the sector, the firm and the plant, where data are made available. Published financial and other relevant types of data are available from Statistics Canada and from the financial reports of some firms.

Moreover, as specified in the MISA Issues Resolution Committee Report (June 1990, p. 98) "Costs of present environmental regulatory initiatives and mandated requirements other than the proposed MISA regulations should be considered in assessments to the extent possible, recognizing limitations in capital availability".

Industry representatives suggested that present and potential environmental protection expenses incurred in other provinces or countries by firms operating in Ontario be included in the present MISA-related assessments. They noted that a company has a finite total budget with which to respond to regulatory requirements in all of the jurisdictions in which it operates and this fact should be acknowledged explicitly in the analyses.

While Ontario has no control or responsibility with respect to regulatory

requirements in other jurisdictions or the corporate responses to these requirements, it is recognized that firms have finite resources with which to implement environmental protection requirements, as well as, carry out other desirable business activities. In order to show the implications of the potential MISA-related costs under a wide variety of economic conditions, assessments were carried out which incorporated estimates of costs that some firms claimed would be incurred to meet environmental requirements in other Canadian jurisdictions. Furthermore, because both firms and government face increasingly scarce resources, the assessment of cost-effectiveness and the efficiency of abatement options will receive careful attention.

Industry representatives also asked that costs associated with other present and potential regulatory requirements initiated by the Ontario government (i.e. pay equity, payroll tax increases, etc.) also be included explicitly in the present assessments. The IRC Report states, "Economic assessments of the MISA program should not include non-environmental regulatory costs"(p. 99). It was agreed that only costs associated with **environmental** regulatory instruments (ie. control orders, certificates of approval, etc.) that would be in force from the start of the MISA monitoring program until 2 years after promulgation of the MISA limits regulation for the sector in question, would be included in the present analyses.

The results of the cost-effectiveness analyses will show, given available BAT Option cost and removal estimates, which BAT options or levels of contaminant removal are most cost-effective and which levels of abatement push changes in costs far above changes in pollutant removal. The analyses presented in this report will show, as clearly as possible, the likely consequences of potential MISA-related compliance costs that will be helpful in forming judgements and making informed choices. However, results of economic and financial assessments presented here are not likely to reveal an unambiguous, unique or widely accepted choice from among the potential representative abatement scenarios.

## Endnotes to Chapter 2

1. A small business is defined as having 100 or less employees and/or gross annual revenues of $1 million or less.

# 3.0 STRUCTURE OF THE ONTARIO PULP AND PAPER INDUSTRY

*The pulp and paper industry in Ontario and Canada has a long history of durability under varied economic circumstances. Ontario is home to 37 mills, of which 27 discharge directly into provincial surface waters and are subject to MISA regulations. The pulp and paper industry is the fifth leading manufacturing industry employer in Ontario, behind motor vehicle parts, motor vehicles, primary steel and electronic equipment. Newsprint and market pulp for export are the primary products of Ontario mills in terms of quantities produced. Other, higher value-added paper products constitute about 28% of total production. The primary market for Ontario newsprint and market pulp is the U.S. while the majority of other paper products are shipped to domestic consumers. Some experts predict a strong recovery for the pulp and paper industry when the economy recovers to the historical growth rates experienced by the industry between 1982 and 1987. Others believe that the newspaper publishing industry is permanently contracting and future growth in demand and prices will be constrained as a result.*

## 3.1 Industry Overview and Importance

The importance of the pulp and paper industry in Ontario and Canada and the product markets they serve are reviewed in this Chapter. This review will include an assessment of the importance of the industry to the national and provincial economies, identification of key product markets and an examination of historical trends and the future outlook for these markets.

The pulp and paper industry in Canada consisted of 144 mills during 1990. Ontario is home to 37 mills, of which 27 discharge directly into provincial surface waters and are subject to MISA regulations (CPPA Reference Tables, 1990).

Ontario's pulp and paper industry has played a major part in the economic development of Ontario. At the turn of the century, enormous supplies of high quality fibre, low cost energy and tariff-free access to major newspaper publishers fostered the development of newsprint mills as the dominant focus of the industry.

Growth of kraft pulp as an important furnish ingredient for paper production during the 1950s and 1960s led to a second round of expansion as Ontario entered the market bleached kraft pulp business. Further paper machine integration and additional expansions over the past 30 years have placed Ontario in its current capacity position.

Table 3.1 summarizes production capacity and other information for each of the 27 Ontario pulp and paper

## TABLE 3.1
## 27 Direct Discharge Pulp and Paper Producers Final Products, and Employment, 1990*

| Company | Product | Integrated** | Production tonnes/year | Employees |
|---|---|---|---|---|
| Boise Cascade, Fort Frances | Market Pulp/ Groundwood specialty | Y | 219,000<br>281,000 | 1,000 |
| CPFP, Dryden | Market Pulp/<br>Fine Papers | Y | 131,000<br>292,000 | 1,030 |
| CPFP, Thunder Bay | Market Pulp/<br>Newsprint | Y | 467,000<br>450,000 | 2,033 |
| Domtar, Cornwall | Specialty Papers/<br>Board | Y | 219,000<br>73,000 | 1,450 |
| Domtar, Red Rock | Linerboard<br>Newsprint | Y | 230,000<br>65,000 | 650 |
| E.B. Eddy, Espanola | Market Pulp<br>Fine Papers | Y | 344,000<br>57,000 | 919 |
| James River Marathon | Market Pulp | N | 155,000 | 400 |
| K-C, Terrace Bay | Market Pulp | N | 405,000 | 730 |
| Malette, Smooth Rock Falls | Market Pulp | N | 103,000 | 300 |
| Spruce Falls, Kapuskasing | Newsprint | Y | 348,000 | 919 |
| Que. & Ont, Thorold | Newsprint | Y | 310,000 | 1,150 |
| Boise Cascade, Kenora | Newsprint | Y | 289,000 | 850 |
| A-P, Iroqouis Falls | Newsprint | Y | 289,000 | 824 |
| A-P, Thunder Bay Div. | Newsprint | Y | 160,000 | 325 |
| A-P, Fort William Div. | Newsprint | Y | 131,000 | 300 |
| St Marys Paper, Sault Ste | Groundwood Specialties | Y | 250,000 | 520 |
| A-P Provincial Div. | Fine Papers | Y | 137,000 | 802 |
| Noranda, Thorold | Fine Papers | Y | 126,000 | 540 |
| E.B. Eddy, Ottawa | Fine Papers | N | 58,200 | 600 |
| Domtar, St. Catherines | Fine Papers | N | 52,200 | 300 |
| K-C, Huntsville | Tissue | N | 36,000 | 250 |
| K-C, St. Catharines | Tissue | N | 35,000 | 200 |
| Sonoco, Trenton | Boxboard | N | 107,000 | 300 |
| Beaverwood, Thorold | Boxboard | N | 80,000 | 130 |
| Strathcona, Napanee | Boxboard | N | 59,000 | 200 |
| Domtar, Trenton | Corrugating Medium | Y | 113,000 | 140 |
| Mac. Bloedel, Sturgeon Falls | Corrugating Medium | Y | 87,000 | 420 |
| **TOTAL** | | | **4,548,400** | **17,282** |

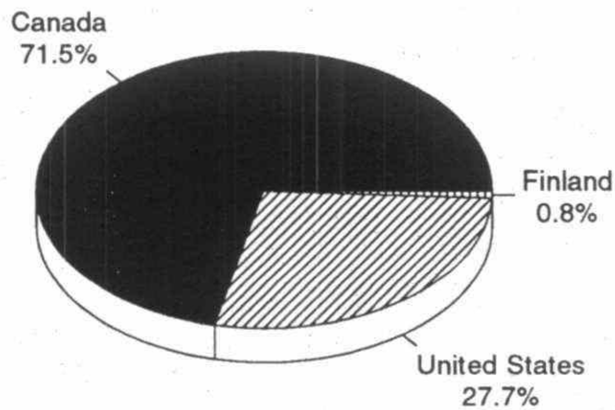
*Production during monitoring phase of MISA. Note table does not reflect closures since then.
**Integrated = Manufacturer and consumer of own pulp
Non-Integrated = Manufacturer of Pulp or Paper only

Sources: Expert Committee Report on Non-Kraft Mills in Ontario, 1990
McCubbin Consultants Inc, September 1991
1990 Lockwood-Posts Directory of the Pulp, Paper and Allied Trades

**Figure 3.1**

## Ownership of Ontario Pulp and Paper Industry

(Percent - Pulp Capacity)




Source: Great Lakes Forestry Centre, 1989

producers which discharge effluent directly into Ontario receiving waters. Mills are grouped by product and, as can be seen, produce outputs that represent at least 8 different product markets. During 1989, approximately 19,500 people were employed full time at all plants operating in Ontario where they produced 8.7 million tonnes of pulp and paper products (CPPA Reference Tables, 1990). During 1990, the 27 mills subject to MISA requirements produced about 5 million tonnes of saleable pulp and paper products while employing over 17,000 people in the province (Table 3.1).

In terms of employment, the pulp and paper industry is the fifth leading manufacturing industry in Ontario, behind motor vehicle parts, motor vehicles, primary steel and electronic equipment (Statistics Canada, Manufacturing Industries Of Canada, Ontario: 31-203). When timber harvesting and management jobs are included, the pulp and paper industry directly employs approximately 75,000 people in Ontario, according to figures compiled by the Ontario Forest Industries Association (OFIA) (Toronto Star, October 26, 1991, p. C1).

As shown in Figure 3.1, Canadian companies own 72% of Ontario's pulp and paper mills while American companies own another 28%. A Finnish firm owns a share of one mill, St. Marys Paper Inc.

Historically, pulp and paper manufacture has been one of the most durable industrial activities in the province. Some mills have been operating continuously for over 90 years although the machinery and equipment in them have been replaced and improved. Mills continued to operate through the depression of the 1930s and the recession of the early

1980s. Even though some of the firms that owned the mills have been forced into bankruptcy and even dissolution, mills were invariably sold to new owners and kept operating. These transactions have often been accompanied by major capital improvements and expansions.

Between 1970 and 1991, only one entire Ontario mill operation, the Canadian International Paper facility in Hawkesbury on the Ottawa River, was closed permanently. This decision was the result of several factors including antiquated and obsolete equipment, declining demand for the plant's highly specialized product (i.e. dissolving sulphite pulp to make cellophane) and persistent financial losses. The plant also faced large expenditures to comply with long standing environmental requirements.

In June 1991, as a result of the current economic environment, Abitibi-Price Inc. closed a 400-employee, 170,000-tonnes per year, sulphite newsprint mill in Thunder Bay (Thunder Bay Division) for at least two years (The Globe and Mail, June 1, 1991, p. B16). In October of 1992, Abitibi-Price announced that the mill would not re-open.

Also in June of 1991, Kimberly-Clark, the majority owner of Spruce Falls Power and Paper Co. in Kapuskasing, announced plans to downsize operations at that mill which would have resulted in the layoff of 1,200 of its 1,450 employees. However, in August of 1991, a deal was struck to transfer the mill to a partnership of the Spruce Falls mill employees and Tembec Inc., a Montreal-based pulp and paper company. Central to the deal was the purchase of the Smoky Falls Hydroelectric station by Ontario Hydro for $140 million. The Government of Ontario sanctioned the purchase and guaranteed part of the financing.

The new owners of the Kapuskasing mill plan capital improvements and product line revisions which could reduce the workforce by 600 in 1992 and by an additional 130 jobs by 1994 (The Globe and Mail, August 15, 1991, p. B1).

During 1991, three other mill closures were announced in Quebec (Port Cartier, Matane and Jonquiere) and one in New Brunswick (Atholville). The closing of these four mills represent a decrease in pulp capacity of about 445,000 tonnes.

A pulp and paper mill consists of two major asset categories: the processing/manufacturing plant and the "wood limits" (ie. the rights to harvest timber from specified tracts of forest near the mill). The wood limits are often the most valuable of the two. Throughout eastern Canada, virtually all available wood limits are allocated to existing mills and their owners. Consequently, a firm cannot easily move to another province unless it can purchase new wood harvesting rights or a mill that already has timber rights appended to it. Historically, when a company has faced financial difficulty, invariably someone has been willing to buy the mill with its associated timber rights. Nevertheless, transactions can be difficult in the transitional period for Mill employees and their communities. For instance, workers have lost all of their accrued benefits as a result of the sale of the mill.

Prospects for continuing the pattern of durability exhibited by this industry are uncertain given recent changes in key structural and institutional features of the industry and its markets. For example, the Canada-US Free Trade Agreement is subjecting Ontario mills to greater competition, especially paper product producers. Furthermore, technical advances that permit new types of wood and fibre to be processed in locations where trees can regenerate and grow faster than in Ontario are fostering the growth of formidable competitors.

For example, during the past decade new investment and capacity growth has been located in the Southern U.S. primarily because of the development of processing technologies that can utilize local wood species in the Southern U.S. Lower costs for freight, labour and wood have also contributed to this trend. Consequently, technological advances in the production of alternate wood species has reduced the probability that the strategic value of wood alone would be enough to attract new investors.

Finally, the growth of recycling activities in Ontario and in the markets which Ontario mills serve are changing the demand and marketing patterns facing Ontario paper producers.

**Table 3.2**

**Northern Ontario**
**Community Dependence on Pulp and Paper Industry**
**Companies Subject to MISA Regulations**

| Community (District) | Est. Labour Force | Company Jobs | Approx % Lab Force Affected | Companies Affected |
|---|---|---|---|---|
| **NORTH WEST** | | | | |
| Red Rock | 1,650 | 650 | 39 | Domtar |
| Terrace Bay | 2,350 | 730 | 31 | Kimberly-Clark |
| Dryden | 3,400 | 1,030 | 30 | C.P. Forest Products |
| Marathon | 1,900 | 400 | 21 | James Riv-Marathon |
| Fort Frances | 3,100 | 1,000 | 32 | Boise Cascade |
| Kenora | 5,500 | 850 | 15 | Boise Cascade |
| Thunder Bay | 50,300 | 3,000 | 6 | Abitibi; C.P. Forest; Provincial Paper |
| **PAPER COMMUNITIES** | 68,200 | 7,660 | 11 | |
| TOTAL N.W. | 117,000 | | 7 | |
| **NORTH EAST** | | | | |
| Espanola | 2,660 | 919 | 35 | E B Eddy |
| Iroquois Falls | 2,700 | 824 | 31 | Abitibi-Price |
| Kapuskasing | 4,980 | 919 | 19 | Spruce Falls |
| Smooth Rock | 940 | 300 | 32 | Malette |
| Sturgeon Falls | 2,960 | 420 | 14 | MacMillan-Bloedel |
| Sault Ste. Marie | 36,140 | 520 | 2 | St. Marys Paper |
| **PAPER COMMUNITIES** | 50,380 | 3,902 | 8 | |
| TOTAL N.E. | 255,000 | | 2 | |

Source: Ministry of Natural Resources (1991), Ministry of Treasury and Economics (1992)

Although the pulp and paper industry has long utilized varying amounts of waste paper along with virgin fibre, mills and pulping processes in Canada and Ontario are oriented toward primary fibre. Secondary fibre or paper stock has accounted for about 20% of total annual pulp furnish for making paper in Canada. Moreover, secondary fibre is directed primarily to lower grades of paper such as box board, filler, wall board and corrugating medium. Only 18 percent of the newsprint produced in Ontario contains post-consumer waste paper.

Over the past several years, declining solid waste disposal capacity and growing environmental awareness have motivated North American, and especially U.S., municipalities to pressure newspaper publishers to use newsprint with a high proportion of secondary fibre content. Publishers, in turn, demand newsprint containing recycled fibre. Canadian newsprint producers who are located and technically structured to harvest virgin fibre and forest residues are evaluating ways and means of producing newsprint with a greater content of post-consumer waste paper.

Industry representatives have cautioned that, because of these developments, closed facilities in Ontario may not be reopened as readily as has occurred in the past.

**Regional Importance of Pulp and Paper Mills**

Approximately 15 of the pulp and paper mills subject to MISA requirements are located in small Northern communities where they provide the major, if not the only, source of manufacturing employment and constitute the economic foundation for most of these areas.

The year 1986 is the last year for which Statistics Canada collected data on the regional activities of the Paper and Allied industry companies. They reported purchases of supplies and services by pulp and paper industries in Northern Ontario of $1.1 billion (Statistics Canada, Cat.31-209, 1986).

Table 3.2 shows mill employment relative to the estimated labour force for mills located in Northern Ontario. The data indicate that, in most Northern pulp and paper communities, a quarter to a third of the labour force is directly employed by the industry.

Even in larger communities such as Sault Ste Marie and Thunder Bay, where employment is available in other manufacturing and service sectors, pulp and paper mill payrolls and expenditures are vital to the economic health of these communities. There are four mills located in the Southern Ontario cities of Thorold and St. Catharines where many alternative employment opportunities exist. Even so, these mills make a substantial contribution to the local economies in terms of income and expenditures.

Markets served by the pulp and paper industry may be apportioned into three broad product categories: market pulp, newsprint, and other paper and paperboard products. The total amounts for wood pulp and basic paper and board produced in Canada, Ontario, Quebec and British Columbia during 1990 are presented in Table 3.3. Ontario produces about 18 percent of the pulp

and 25 percent of the basic paper and board manufactured in Canada.

Ontario plants produce market pulp, newsprint, groundwood specialty printing papers and some packaging board. Currently, Ontario mills have the capacity to produce about 1,000,000 tonnes per year of printing and writing papers and Ontario paper mills devote the greatest proportion of production among all provinces to higher value papers (Great Lakes Forestry Centre, 1987). In 1990, Ontario consumed 14% of the fibre in Canada and produced 28% of the value of shipments (OFIA). Figure 3.2 displays the estimated capacities of major products for the 27 Ontario mills subject to MISA requirements. This distribution is similar to the Ontario industry as a whole, in that newsprint is the dominant product with market pulp a close second.

The next section of this report looks at Ontario's role in the market pulp, newsprint and other paper and board markets.

## 3.2 Market Pulp

Pulp is an intermediate product consisting of natural or chemically treated wood fibres in a slurry which is used to make paper products. Pulps are produced from wood or other cellulosic raw materials by means of a variety of different processes using various combinations of chemical, mechanical and thermal inputs. One of the most demanded pulping processes produces sulphate or kraft pulp with which all types of paper and paperboard products can be manufactured, including newsprint, fine papers, wrapping and packaging papers and boxboard.

Kraft pulp may be produced by an integrated mill where the pulp slurry is sent directly to paper machines on the site where newsprint, fine papers or other products are manufactured. Any pulp not used in the mill may be sold in both domestic and international markets.

Non-integrated kraft pulp mills produce pulp that is only for sale to other mills which make paper. Pulp that is sold outside of the mill in which it is produced is called "market pulp". Market pulp has become an internationally traded commodity because of the selective uses of various grades of pulp to provide distinct properties for selected products. The cost of this ingredient is one of the key factors in the overall cost of manufacturing paper products.

**Table 3.3**

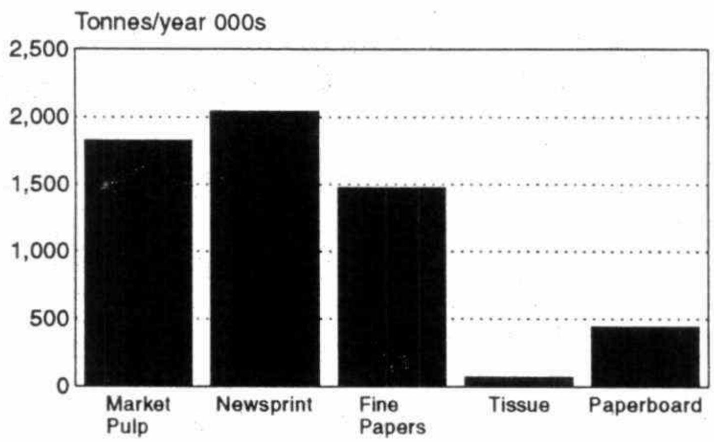
**Production of Wood Pulp and Basic Paper and Board, 1990 (000's of tonnes)**

| | Wood Pulp | % | Basic Paper and Board | % |
|---|---|---|---|---|
| Canada | 22,836 | 100 | 16,526 | 100 |
| **Ontario** | 4,188 | 18 | 4,088 | 25 |
| Quebec | 7,217 | 32 | 6,964 | 42 |
| British Columbia | 6,799 | 30 | 2,994 | 18 |

Source: Canadian Pulp and Paper Association-Reference Tables, 1990

**Figure 3.2**

Ontario Pulp, Paper and Paperboard Production Capacity for 27 Mills Subject to MISA




Source: Table 3.1

The total annual capacity for producing chemical paper grade pulps in Ontario in 1990, according to the Canadian Pulp and Paper Association (Canadian Pulp and Paper Capacity 1991-1993), is 2.8 million tonnes. This amount represents approximately 21% of total Canadian capacity. The total capacity for market chemical pulp in Ontario was 1.8 million tonnes (Canadian Pulp and Paper Capacity 1991-1993). As shown in Table 3.4, the 9 kraft mills in Ontario shipped a total of 1.6 million tonnes of market pulp.

The proportion of market pulp to total pulp produced depends, in part, on the price for market pulp relative to prices of the paper products made by the firm that produces the pulp. If, for example, an integrated company is faced with a "low" price for market pulp relative to prices for paper products it can produce, the firm will have an incentive to divert more pulp to internal paper product output. Conversely, a high price for market pulp relative to prices for manufactured paper products will induce firms to offer more pulp for sale directly (Bonsor, McCubbin and Sprague, 1988).

Ontario mills produce primarily Northern Bleached Softwood Kraft (NBSK) pulp which is regarded by the industry as the premium strength/reinforcing grade for making coated papers, writing papers and tissue. The climate of the north are favourable locales for the growth of slow-growing, cold weather wood species such as Jack Pine, Norway Pine, Black and White Spruce, and Balsam Fir. These species are often harvested at an age of 70 to 100 years old and possess wood morphology characteristics favourable to paper-making including slender, thin-walled fibre dimensions and a low fibre coarseness ranking. The fibre characteristics of Northern Bleached Softwood Kraft pulp yield papers with excellent strength, formation and printing qualities.

Because a large proportion of the Canadian pulp and paper industry consists of integrated mills, and because the Canadian market is small relative to the U.S. market, domestic demand for market pulp is not large. Consequently,

**Table 3.4**

**Shipments of Ontario's Products**

| | Canada | U.S. | Other | Total |
|---|---|---|---|---|
| **MARKET PULP** | | | | |
| 1980 - 000s tonnes | 341 | 948 | 115 | 1,404 |
| 1989 - 000s tonnes | 439 | 1,063 | 105 | 1,607 |
| 1980 - % | 24 | 68 | 8 | 100 |
| 1989 - % | 27 | 66 | 7 | 100 |
| **NEWSPRINT** | | | | |
| 1980 - 000s tonnes | 161 | 1,589 | 9 | 1,759 |
| 1989 - 000s tonnes | 192 | 1,659 | 13 | 1,864 |
| 1980 - % | 9 | 90 | 1 | 100 |
| 1989 - % | 10 | 89 | 1 | 100 |
| **OTHER PAPER AND PAPER BOARD** | | | | |
| 1980 - 000s tonnes | 1,326 | 376 | 38 | 1,760 |
| 1989 - 000s tonnes | 1,598 | 774 | 19 | 2,391 |
| 1980 - % | 75 | 22 | 3 | 100 |
| 1989 - % | 67 | 32 | 1 | 100 |

Source: Forestry Canada, 1990

87% of Canadian market pulp production is sold to export markets, mainly in the U.S. (CPPA Reference Tables, 1990).

Data in Table 3.5 show that, of the total 6.3 million tonnes of kraft pulp exported by Canadian firms in 1990, 50% went to the United States. Europe receives 26%, Japan 11%, the U.K. 3% and the rest of the world 10%.

The United States and Britain charge no tariffs on Canadian wood pulp but European Economic Community members allow pulp imports duty free up to a maximum tonnage. Quantities of pulp imported in excess of this amount are subject to tariffs.

Similar to the national industry, Ontario shipped two-thirds of its market pulp production to the United States in 1989, with less than 10% shipped to other export markets (Table 3.4). With U.S. consumption of wood pulp totalling 57 million tonnes in 1989, (CPPA Reference Tables, 1990) Ontario meets only 2% of total U.S. consumption.

Total world capacity for Northern Bleached Softwood Kraft pulp is approximately 15.5 million tonnes produced by about 75 mills. Proportioned among the three primary producing regions, North America produces 57% of world capacity, Nordic Group (Finland, Sweden and Norway) 28% and Europe (Austria, Czechoslovakia and the Soviet Union) 15%. The 9 Ontario mills possess approximately 8% of total NBSK pulp world capacity and must compete with mills in Quebec and British Columbia as well as international producers.

Approximately 42 Canadian pulp producers currently supply 32 % of the world's pulp exports in competition with over 200 other companies which are located in the United States, Finland, Sweden, and, to a growing extent, Portugal and Brazil (CPPA Reference Tables - 1990). The market for kraft pulp can, therefore, be characterized as competitive.

Currently, market NBSK pulp producers are being challenged by substitute pulp

## Table 3.5

**Canadian Sulphate Pulp Exports by Area for Selected Years (000's of Tonnes)**

| YEAR | TOTAL | U.S. | U.K. | EUROPE | JAPAN | ASIA | REST OF WORLD |
|---|---|---|---|---|---|---|---|
| 1965 | 2,037 | 1,520 | 105 | 172 | 133 | 18 | 89 |
| 1975 | 4,181 | 2,156 | 316 | 1,119 | 377 | 121 | 92 |
| 1980 | 6,197 | 2,910 | 322 | 1,742 | 774 | 258 | 191 |
| 1985 | 6,051 | 3,078 | 223 | 1,340 | 717 | 513 | 180 |
| 1990 | 6,270 | 3,151 | 171 | 1,630 | 706 | 487 | 125 |

Source: Canadian Pulp and Paper Association-Reference Tables, 1990

grades, which are usually priced below NBSK pulp. For example, Bleached Radiata Softwood Kraft (BRSK) pulp produced mainly in Chile and New Zealand is utilized in a wide variety of products including fine papers, bleached packaging and mechanical fibre-containing printing grades. Chile and New Zealand are favourable locations for the growth of radiata pine and the production of this grade of pulp is growing rapidly. This species is typically harvested at an age of 15-25 years old making it more productive than slower growing northern species.

As well, Southern Bleached Softwood Kraft (SBSK) pulp, produced in the southern United States is highly regarded in Fluff Pulp products such as diapers and is also used in various paper grades. The relatively fast growing areas of the southern United States is a favourable locale for the growth of various southern pine species which make up the pulp grade.

In summary, Northern Bleached Softwood Kraft (NBSK) is the primary market grade pulp produced by Ontario mills. Most of the market pulp produced by Ontario mills is exported to a mature U.S. market with small amounts going to customers outside of North America. Trade among the U.S., Canada and Britain is stimulated by the fact that there are no tariffs on wood pulp in any of these nations. Therefore, prices for market pulp are determined in competitive international markets over which pulp producers in Ontario have little control. Competition from faster growing, cheaper Bleached Radiata and Southern Bleached Softwood Kraft pulp is escalating.

## Table 3.6

**Sources Of U.S. Wood Pulp Supply**

| | U.S. Pulp Production | | Imports from Canada | | Imports from Other Sources | |
|---|---|---|---|---|---|---|
| Year | 000's tonnes | % | 000's tonnes | % | 000's tonnes | % |
| 1965 | 30,838 | 91.6 | 2,556 | 7.6 | 288 | 0.8 |
| 1970 | 39,505 | 92.6 | 3,008 | 7.1 | 134 | 0.3 |
| 1975 | 39,234 | 93.4 | 2,683 | 6.4 | 78 | 0.2 |
| 1980 | 46,247 | 92.6 | 3,516 | 7.0 | 180 | 0.4 |
| 1985 | 49,051 | 92.5 | 3,551 | 6.7 | 404 | 0.8 |
| 1990 | 57,217 | 92.9 | 3,844 | 6.2 | 518 | 0.8 |

CPPA Reference Tables 1985, 1990.

## 3.3 Newsprint

Newsprint is the dominant product of the Canadian and Ontario pulp and paper industries. Newsprint currently accounts for about 45% of total provincial paper production although this share has been falling steadily since 1970 when it accounted for 60% of total product output. Moreover, newsprint production in Ontario has grown by only 0.3% per year since 1970 (Great Lakes Forestry Centre, 1987 p.13).

Canadian mills produced over 9 million tonnes of newsprint in 1990, accounting for 55 % of total Canadian paper and paperboard production (CPPA Reference Tables, 1990). The newsprint mills in Ontario produced about 2 million tonnes in 1990 or 22 percent of total Canadian newsprint on 18 paper machines.

Historically, demand for newsprint has grown at a lower rate than world economic growth. This trend may be due to:

1) Shifts in advertising away from newspapers and toward television and radio in developed countries;

2) The demise of many daily newspapers in the U.S. and Canada during the past 20 years.

3) Maturity of newsprint markets in the United States (essentially no new uses for the product); and

4) The desire of advertisers to have their material printed on higher quality paper, such as coated and other grades, primarily for better colour presentation.

Although growth in newsprint consumption in less developed countries of Asia and South America is higher than in North American and European

**Table 3.7**

**Canadian Production, Shipment and Exports of Newsprint for Selected Years (000's of Tonnes)**

| YEAR | TOTAL PROD. | SHIPMENTS | | | | EXPORTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CANADIAN | | TOTAL EXPORTS | | U.S. | | U.K. | | LATIN AMER. | | ASIA | | OTHER | |
| | | | % | | % | | % | | % | | % | | % | | % |
| 1965 | 7,028 | 535 | 8 | 6,492 | 92 | 5,528 | 85 | 341 | 5 | 294 | 5 | 98 | 2 | 231 | 4 |
| 1975 | 7,010 | 784 | 11 | 6,227 | 89 | 4,980 | 80 | 382 | 6 | 455 | 7 | 186 | 3 | 224 | 4 |
| 1980 | 8,622 | 980 | 11 | 7,642 | 89 | 6,118 | 80 | 442 | 6 | 518 | 7 | 267 | 3 | 297 | 4 |
| 1985 | 8,899 | 1,016 | 11 | 7,883 | 89 | 6,593 | 84 | 274 | 3 | 327 | 4 | 455 | 6 | 234 | 3 |
| 1990 | 9,074 | 1,075 | 12 | 7,999 | 88 | 6,423 | 80 | 369 | 5 | 375 | 5 | 398 | 5 | 434 | 5 |

Source: Canadian Pulp and Paper Association-Reference Tables, 1990

markets, the total tonnage is still small relative to consumption in the U.S., Europe and Japan. The United States alone accounted for about 38 percent of the total world newsprint consumption in 1989 (CPPA Reference Tables, 1990).

The large number of newsprint production facilities throughout the world is an important structural feature of the newsprint industry. Many nations have established newsprint, or other paper mills, for a variety of reasons including prestige and the generation of hard currency. Domestic paper production is given high priority for both cultural and economic reasons. Tariff and other trade barriers have been erected against newsprint imports by these countries in order to protect and encourage their domestic industry. These practices have led to steady growth in world newsprint capacity and when demand and business conditions have declined, excess capacity. Price competition among the principle producers in Canada, Scandinavia and the U.S. quickly developed as markets once served by these suppliers were closed by trade barriers. Furthermore, because the U.S. and Western Europe accounted for 60% of total world newsprint consumption (CPPA Reference Tables - 1990), many producers focus their sales efforts on these markets which has led to more intense competition in recent years.

The one million tonnes of newsprint consumed in Canada during 1990 amounts to only 12% of the total Canadian newsprint production as shown in Table 3.7. The remaining 8 million tonnes, which are valued at close to $6 billion, are exported (CPPA Reference Tables - 1990). As with pulp, the United States and Great Britain charge no tariffs on imported Canadian newsprint. Historically, abundant wood supply and tariff-free trade with the U.S. has encouraged the Canadian pulp and paper industry to specialize in producing newsprint for United States customers.

The U.S. itself had a productive capacity of 6 million tonnes in 1990 but consumed 12 million tonnes of newsprint in 1990, leaving an import demand of at least 6 million tonnes (CPPA Reference Tables, 1990). As a result, 80% of Canadian exports (6.4 million tonnes) in 1990 went to the United States where they comprised 53% of that nation's newsprint consumption. The remaining Canadian exports go to Europe, Britain, Latin America and Asia. Table 3.7 reveals that the Canadian share of newsprint exports to the United States has declined while corresponding shares in Asian and other market areas have grown.

As shown earlier in Table 3.3, Ontario ships approximately 90% of its newsprint production to the U.S. where it accounts for about 14% of U.S. consumption. This represents a modest drop from 1980 levels when Ontario exports accounted for 15% of U.S. consumption.

According to Anderson and Bonsor (1985), the principle destinations for Ontario newsprint exports are cities in the midwestern and northeastern U.S. This product and market specialization have left Canadian and Ontario newsprint producers vulnerable to business cycles in the U.S. Furthermore, because newsprint and other pulp and paper products are traded in U.S dollars, a decline in the value of the Canadian dollar against its U.S. counterpart will

cause windfall gains to those Ontario producers heavily dependent on U.S. markets. Conversely, a rise in the value of the Canadian dollar relative to its U.S. counterpart will result in reduced revenues, even if total sales volumes remains unchanged. The high value of the Canadian dollar relative to the U.S. combined with the prevailing recession and excess production capacity to erode profits across Ontario mills.

In 1965, 71% of the total newsprint sold in the U.S. originated from Canada. However, by 1990, Canada's share had dropped to 53% while U.S. producers, who supplied 26% of their own market in 1965, increased their share to 46% by 1990. Other suppliers' share of the U.S market declined from 3% in 1965 to just over 1% in 1990 (CPPA reference Tables, 1984 & 1990). New suppliers to U.S. markets have built mills in the Southern U.S., the result, in part, of technical advances that have allowed the processing of hitherto unusable Southern pines species indigenous to the region into a high quality, competitive product. As shown in Table 3.8, the average annual rate of growth of U.S. newsprint production has outstripped growth in both U.S. consumption and Canadian production in the last 20 years. During the last 5 years, U.S. production of newsprint grew by 22% while Canadian newsprint production grew by less than 1%.

Demand for newsprint is currently weak. With North American newsprint consumption totalling 13 million tonnes and production about 15 million tonnes, available supply currently exceeds demand by 2 million tonnes or approximately 13% (CPPA reference tables 1990). This excess supply has led to discounting, by as much as 17-31% from announced prices and to higher average freight bills per tonne of product shipped because firms "chase" the market into regions not traditionally served by Ontario mills.

In summary, while newsprint is still the dominant product of the Ontario industry, newsprint production has been declining as a percentage of total Ontario paper production over the past 20 years. The majority of Ontario newsprint is exported to the U.S. where producers enjoy tariff-free trade. However, this market dependency has left Ontario newsprint producers vulnerable to business cycles in the U.S. economy, to fluctuations in currency exchange rates and to U.S. competitors who have successfully entered this product market.

**Table 3.8**

**U.S. Consumption and U.S. and Canadian Production of Newsprint 1970-1990 (000's of tonnes)**

| YEAR | U.S. PROD. | U.S. CONSUMP. | CANADIAN PROD. |
|---|---|---|---|
| 1970 | 3,143 | 8,884 | 7,909 |
| 1980 | 4,240 | 10,300 | 8,622 |
| 1985 | 4,924 | 11,587 | 8,899 |
| 1990 | 5,997 | 12,126 | 9,074 |
| | | | |
| AVG. ANNUAL GROWTH RATE | 4.5% | 1.8% | 0.7% |

Source: Canadian Pulp and Paper Association-Reference Tables - 1984, 1986, 1990

## 3.4 Fine Papers, Paperboard and Other Paper Products

Data presented in Table 3.9 show production of paper and paperboard in Canada. While other paper and paperboard shipments accounted for 17% of total Canadian exports by tonnage in 1990, these products earned 21% of the value of export shipments or $3.1 billion in 1990 (CPPA, Reference Tables 1990). Recalling Table 3.2, production in Ontario of the various grades included in this category totalled approximately 2.4 million tonnes in 1989, about 30% of total Canadian production. The primary customers for these products are domestic but Ontario managed to increase its proportion of output shipped to the U.S. from 22% in 1980 to 32% in 1989 (Table 3.4).

Paper and Paperboard Capacity represents approximately 28% of total Ontario productive capacity.

### Printing and Writing Papers

Canadian book, printing and writing paper production amounted to 3.6 million tonnes in 1990, as shown in Table 3.9, and accounted for over 20% of Canadian paper product output, second only to newsprint. Production of printing and writing papers in Ontario currently totals about one million tonnes per year and has experienced an annual average rate of growth of 4.4% per annum since 1970 (Great Lakes Forestry Service, 1987).

Printing and writing papers include a wide range of paper types and specifications for a broad variety of end uses.

**Table 3.9**

**Canadian Production of Paper and Paperboard, 1990 (000's of Tonnes)**

| | | |
|---|---|---|
| Newsprint | | 9,074 |
| Book, Printing and Writing Paper | | 3,599 |
| Paperboard | | 2,806 |
| Boxboard | 761 | |
| Corrugating Medium | 741 | |
| Linerboard | 1,304 | |
| Tissue and Special Papers | | 495 |
| Kraft Paper | | 497 |
| TOTAL | | 16,471 |

Source: Canadian Pulp and Paper Association-Reference Tables, 1990

Consumption of both coated and uncoated mechanical printing and writing papers has grown rapidly during the last ten years. During the 1980s, the rate of demand growth for coated and uncoated groundwood printing and writing papers outpaced not only the U.S. economy but also their wood-free counterparts by a considerable margin (Sandwell Swan Wooster, 1986). Groundwood specialty papers are essentially a higher quality newsprint in terms of special properties such as colour, fillers, surface characteristics and light weight. Trees growing in northern Ontario are considered to be particularly suitable for the production of supercalendered papers and other groundwood specialty papers. Access to these fibre resources give Ontario mills a comparative advantage for groundwood specialty papers (Sandwell Swan Wooster, 1986).

## Containerboard and Kraft Packaging

Containerboard and kraft packaging papers represented 10 % of Canadian shipments for 1990. The 25 mills in Canada that produce containerboard, kraft paper or both have a total annual capacity of 2.6 million tonnes (NLK Celpap Canada, 1990). Canada produces approximately 4% of world production of 51 million tonnes, while the United States is the primary world producer, accounting for over 40% of total global production (CPPA Reference Tables 1990). Of the 27 Ontario mills subject to MISA requirements, one (Domtar, Red Rock) produces linerboard, one (E.B. Eddy, Espanola) produces kraft papers and two (Domtar, Trenton and MacMillan Bloedel, Sturgeon Falls) produce corrugating medium. These four mills constitute a total annual capacity of 488,000 tonnes, accounting for approximately 19% of total Canadian capacity for these paper product grades.

World consumption of containerboard represents about 26% of the total pulp and paper industry production (NLK Celpap Canada, 1985). Containerboard demand and its proportion of total pulp and paper industry output are expected to decline because:

a) Shippers are using more bulk container shipments rather than boxes of smaller numbers of units (i.e. less containerboard per unit of product shipped) and

b) Continued replacement of container board with plastic packaging materials.

## Tissue

Tissue products contributed 2% to Canadian pulp and paper shipments for 1990 (CPPA, Reference Tables 1990). Tissue is a final consumer product and represents a stable market both in demand and price relative to other pulp and paper commodities. Tissue is split into two categories, sanitary (e.g. toilet, napkins, towels) and non-sanitary (e.g. wrapping, fruit wrap).

Because of the low density or weight to volume ratio of this product, mills tend to be located as close as possible to markets in order to minimize freight costs. Only about 2% of world tissue production is exported to off-shore markets (NLK Celpap Canada, 1990). Canada exports 12% of its production to the U.S. and produces about 4% of the total global production (CPPA reference tables 1990). In Ontario, 2 mills (Kimberly-Clark Huntsville and St. Catharines) subject to MISA requirements produce approximately 70,000 tonnes per year of tissue products (Table 3.1). These two mills represent about 14% of total Canadian tissue production.

## International Trade

Canadian producers of fine paper, linerboard, corrugating medium and tissue export only 23% of their total annual production of these paper products (Bonsor et al, 1991). Non-newsprint producers were, until the late 1980s, protected from import competition by Canadian tariff barriers. Similarly, Ontario producers faced tariffs on exports to the U.S. and other markets. The presence of tariff barriers induced non-newsprint paper segments of the industry to orient themselves towards domestic

rather than export markets. Therefore the relatively small size of the Canadian domestic market for paper products has constrained Canadian pulp and paper producers to build small plants relative to those in the U.S. and Europe which compete in this market segment.

The Free Trade Agreement (FTA) with the United States includes an accelerated removal of tariffs that started with the General Agreement on Trade and Tariffs (GATT) negotiations. Table 3.10 indicates that Canada imposed much higher tariffs on paper products during the 1960's than did the U.S. which, at that time, protected Canadian producers from competition. Substantial reductions in Canadian tariffs have been accomplished and, under the terms of the FTA, tariffs on paper products will be reduced over a five-year phase-out period with equal reductions annually.

Faced with the elimination of tariff protection, Ontario producers of non-newsprint paper products will be subject to increasing competition in their traditional domestic product markets. Primary competition will come from the United States where the industry currently produces 32%, 41% and 42% of the world's supply of printing and writing papers, tissue and board respectively in plants that are, on average, much larger than Canadian plants. It is likely that Ontario mills will have to increase their size in order to achieve economies of scale, reduce per unit costs and allow Ontario mills to compete both domestically and for export market shares. Some mills may shift production to products for markets not currently served by U.S. producers.

## 3.5 Industry Outlook

This section briefly examines long-term demand prospects for the Canadian and Ontario pulp and paper industry from the time of writing.

**Table 3.10**

**Canadian and American Tariffs for Selected Pulp and Paper Products 1967 and 1990**

| PRODUCT | CANADIAN TARIFF | | | U.S. TARIFF | |
|---|---|---|---|---|---|
| | 1967 | 1990 | | 1967 | 1990 |
| Pulp | Free | Free | | Free | Free |
| Standard Newsprint | Free | Free | | Free | Free |
| Groundwood specialties coated | 22.5% | 1.5% | | 5% | 1.5% |
| uncoated | 22.5% | Free | | 6% | Free |
| Fine Paper Commodities | 22.5% | 3.9% - 5.8% | | 15% - 20% | Free - 2.4% |
| Fine Paper Specialties | 22.5% | 3.9% - 5.5% | | 8.5% - 12% | Free - 1.4% |
| Linerboard | 22.5% | 3.9% | | 6.5% | Free |
| Corrugating Medium | 22.5% | 2.4% | | 20% | 2.4% |

Note: Under the Free Trade Agreement signed with the United States in 1988, these tariffs are scheduled to disappear on both sides of the border.

Source: Domtar Inc. Annual Report, 1990.

Table 3.11 provides selected examples of the per-capita consumption of all major paper products including newsprint, paper bags, liner boards and writing materials. The United States consumes more paper per-capita than any other nation in the world - some 311 kilograms in 1990. Canada's consumption is a third less at 215 kilograms and is about the same as Switzerland. The relationship between per-capita consumption and the general standard of living are immediately apparent.

The general range for per-capita consumption for developed countries is 100 kg - 320 kg. Less developed nations consume between a few kilograms to 100 kg per person per year. However, many less developed nations are currently experiencing the highest rates of growth in population, GNP and incomes which are key determinants of per-capita consumption of paper. Future demand for paper in developing countries is potentially enormous.

Some estimates place world demand in the year 2000 as high as 360 million tonnes compared to 237 million metric tonnes in 1990. This growth would amount to a volume increase of 50% or more over a ten year period (James R. Taylor, How to Survive in Global Markets and Beyond, Tappi Journal, P 103, October 1990).

The United Nations Food and Agricultural Organization (1986) presents a more conservative forecast whereby consumption of all paper and board products rise by 3.4%-3.6% a year with a total consumption of some 300 million tonnes by the year 2000.

As economic growth continues over the next decade, a strong direct role for Ontario's industry in meeting the projected increase in global per-capita consumption does not seem likely. The province's industry to date has not developed extensive markets outside of Canada and the U.S.

Of particular concern to Ontario producers of pulp and paper products is the U.S. newsprint market. Newspapers constitute the largest single end-use for newsprint in North America. Daily newspapers are the largest sub-group within this sector accounting for three-quarters of total newsprint consumption. Daily newspaper circulation has remained stagnant with the number of copies sold in North America moving from 62.2 million in 1980 to 62.3 million

**Table 3.11**

**Per Capita Consumption of Paper and Board in 1990**

| | Per Capita Consumption Kg |
|---|---|
| **Main Geographic Groupings** | |
| Africa | 6 |
| Asia | 20 |
| Latin America | 26 |
| Europe(East) | 35 |
| Europe(West) | 163 |
| North America | 302 |
| **Main Paper Producing Countries** | |
| Canada | 215 |
| Sweden | 231 |
| Finland | 279 |
| United States | 311 |

Source: Pulp and Paper International Annual Review, 1991

in 1990. The percentage of total U.S. adult population who read a daily newspaper has dropped from 76% in 1970 to 67% in 1980 and finally to 62% in 1990 (Simons, 1991) Some of the factors which contributed to this decline include:

- lower literacy rates
- new competition for reading time, cable television, specialty magazines

Experts in the paper industry are divided on their predictions regarding future growth of newsprint consumption.

- Resources Information Systems Inc. (RISI) predicts a strong recovery from the recession followed by an annual growth rate of 1.3% which is close to the historical growth rate experienced by the industry between 1982 and 1987.
- PaperTree Letter (July 1, 1990) that a structural change has occurred in the newspaper publishing industry and future growth will be limited as a result.

Over the past decade, a growing proportion of newsprint consumed in North America has been by weekly papers, business newspapers, inserts and flyers, catalogues, books and periodicals rather than daily newspapers. Demand for these end-uses increased to roughly 3.4 million tonnes in 1988, or roughly 25% of total consumption. This is more than double the consumption in 1975. By the year 2000, non-newspaper demand for newsprint consumption is expected to reach 31% of total newsprint consumed.

**Table 3.12**

**Projected Annual Demand Growth for Pulp and Paper Products In North America**

| | 1990-95 | 1995-2000 |
|---|---|---|
| Newsprint | 2.1% | 2.1% |
| Printing and Writing | 3.2% | 3.2% |
| Other Paper, Board | 0.6% | 0.6% |
| Total Paper, board | 1.6% | 1.7% |
| Total Pulp | 2.0% | 2.1% |
| Waste Paper | 4.1% | 4.1% |

Source: United Nations Food and Agricultural Organization, 1986

Finally, long-term demand for fine papers appears to be rising. Principal factors that influence this trend are: the growth of service and information industries; the spread of copying machines, and computers; and the use of higher-grade papers for colour-printed advertising. Printing, writing and coated papers have enjoyed a steady expansion of per-capita demand over the 1970's and 1980's from a low of about 35 kg in 1975 to over 55 kg in the late 1980's.

Using Gross Domestic Product trend growth and income elasticities of demand, the Food and Agricultural Organization of the United Nations (FAO)(1986) projected demand growth for pulp and paper products in North America which are displayed in Table 3.12. The FAO projections understate the actual performance up to 1990, but

provide a useful picture of the emerging state of North American demand.

# 4.0 POTENTIAL ABATEMENT PROGRAMS, COSTS AND EFFECTIVENESS

*Technical consultants identified up to 5 Best Available Technology (BAT) Options for each of the 27 mills subject to MISA requirements. Technical removal estimates associated with the abatement technology combinations have been provided for four conventional pollutants Total Suspended Solids (TSS), Biological Oxygen Demand, Total Kjeldhal Nitrogen and Phosphorus and a measure of organochlorines called Adsorbable Organic Halide (AOX).*

*Of five potential BAT Options available for sulphate (kraft) mills, each of the technology combinations would achieve incremental reductions of AOX but only two of them, the least costly and the most costly combination of technologies would reduce Total Suspended Solids (TSS) and Biological Oxygen Demand (BOD) loadings from these mills as well. For each of the remaining 16 non-kraft mills, only 2 or 3 technology combinations were identified for the removal of TSS and BOD.*

*Two measures of cost-effectiveness were computed for each mill and for each process category and compared: the annualized cost per kg of pollutant removed and the incremental annualized cost per incremental kg of pollutant removed.*

*The combination of BAT Options which includes installation of aerated stabilization basins and 100% chlorine dioxide substitution at sulphate mills, aerated stabilization basins at deinking/board/fine papers/tissue mills and activated sludge treatment at sulphite-mechanical and corrugating mills, would be Most Cost Effective for the sector as a whole. Installation of this combination of technologies at all mills could impose a cost of $583-million in capital costs or $94-million total annualized (capital+operating) over 10 years after-tax and could achieve a 77% reduction in TSS, a 96% reduction in BOD and a 70% reduction in AOX loadings.*

*The Most Cost-Effective level of abatement may be compared with the least-cost Maximum Technically Achievable level of control. This level of abatement includes the application of oxygen delignification and extended cooking at sulphate mills, activated sludge treatment and granular filtration at sulphite-mechanical and corrugating mills and activated sludge treatment at deinking/board/fine papers/tissue mills. Pulp and paper mills could incur as much as $1.3 billion in capital costs or $181-million after-tax, annualized over 10 years and they could achieve reductions in TSS of 86%, in BOD by 98% and in AOX of 85%.*

## 4.1 BAT Options for Pulp and Paper Mills

In this Chapter, estimates of the costs of achieving specific degrees of contaminant reduction at each mill are presented and evaluated for specified combinations of abatement technologies or Best Available Technology (BAT) Options.

Abatement technologies for each pulp and paper mill were suggested by McCubbin et al., (1992) and ratified by the BAT Subcommittee of the Joint Technical Committee. BAT Options were specified on the basis of the following criteria:

1. The technologies are "demonstrated",[1]
2. The technologies remove target contaminants, especially AOX from the sulphate (kraft) category;
3. The technologies produce effluents that are non-lethal to trout and Daphnia magna;
4. The technologies involve recycling, re-use and reduction, and minimize transfer to other environmental media;
5. The technologies reduce water usage and minimize wastewater flows.
6. The technologies advance the Ontario Pulp and Paper sector towards the MISA goal of the virtual elimination of the discharge of persistent toxic contaminants to Ontario waterways.

Specified technology trains or BAT Options (these two terms are used interchangeably in this report) have been identified for the following pulp and paper industry process categories: sulphate (kraft) pulping mills, sulphite-mechanical pulping mills, deinking/board/fine papers/tissue mills, and corrugating mills. According to McCubbin (1992), each technology train consists of identical abatement technology combinations at each mill in a category except where site-specific conditions or the fact that the mill had already implemented a particular technology required the exclusion of certain technologies.

Five BAT Options or "technology trains" have been identified for sulphate (kraft) pulping mills, four for the deinking /board/fine papers/tissue mills while three BAT Options have been defined for each of the remaining two types of mills. They are described in more detail in the following section and in McCubbin Consultants Inc.(1992).

## 4.2 Input Data and Assumptions

Table 4.1 lists the technologies identified by McCubbin Consultants Inc. (1992) as being the "best available" for each process category, distinguishing between internal process changes and external treatment technologies. Nine of the eleven technologies postulated for the sulphate (kraft) category may be considered internal process changes while only external, add-on secondary treatment technologies are identified for the remaining 18 non-kraft mills. At each mill the technology trains were selected to provide examples of practical ways of implementing the various technologies,

## Table 4.1

### Abatement Technologies and Abbreviations By Process Category

| CATEGORY | TECHNOLOGY | ABBREVIATION |
|---|---|---|
| SULPHATE | | |
| 1. | Internal Spill control* | INT |
| 2. | Additional Washing Stage* | WASH |
| 3. | High Chlorine Dioxide Substitution* | HSUB |
| 4. | 100% Chlorine Dioxide Substitution* | 100% |
| 5. | Aerated Stabilization Basin♦ | ASB |
| 6. | Conversion of bleach plant* | CONBP |
| 7. | Upgrade chip processing* | CHIP |
| 8. | Oxygen delignification* | OXY |
| 9. | Extended cooking* | XCOOK |
| 10. | Activated Sludge Treatment♦ | AST |
| SULPHITE-MECHANICAL | | |
| 1. | Activated Sludge treatment♦ | AST |
| 2. | Granular Filtration♦ | GF |
| 3. | Chemically Assisted Coagulation♦ | COAG |
| DEINKING/BOARD/FINE PAPERS/TISSUE | | |
| 1. | Aerated Stabilization Basin♦ | ASB |
| 2. | Activated Sludge Treatment♦ | AST |
| 3. | Chemically Assisted Coagulation♦ | COAG |
| CORRUGATING | | |
| 1. | Activated Sludge treatment♦ | AST |
| 2. | Granular Filtration♦ | GF |
| 3. | Chemically Assisted Coagulation♦ | COAG |
| 4. | Waste liquor incineration system* | LIQ |

* Denotes internal process change
♦ Denotes external treatment technology

achieving target concentrations of key pollution parameters and as a basis for cost estimates.

The technology trains for each process category are listed in Table 4.2 using the abbreviations noted in Table 4.1. Each technology train is an independent and mutually exclusive option, and are not additive. This means that only one BAT Option may be implemented at a mill over the planning period of the present study.

The 27 Ontario pulp and paper mills subject to MISA regulations have recently completed their year-long monitoring program during which up to 88 compounds were statistically detected across the industry. However, the quantities of many of these compounds were extremely small.

Removal estimates were provided for only 5 "indicator contaminants" from the sulphate (kraft) category and 4 from each of the other process categories: TSS, BOD, phosphorus, nitrogenous compounds and Absorbable Organic Halogen (AOX) (for sulphate (kraft) mills only). The last parameter, AOX, is a measure of the organically bound halogens (chlorine, bromine, iodine), that are absorbable on activated charcoal. Some of the constituents of AOX are toxic to fish and other organisms. Because other contaminants beside the five noted above will be removed by

**Table 4.2**

**BAT Optional Trains**
**By Process Category**

| CATEGORY | BAT OPTION | TECHNOLOGIES INSTALLED |
|---|---|---|
| SULPHATE | | |
| | K1 | INT+WASH+HSUB+ASB or AST |
| | K2 | INT+CONBP+100%+WASH+ASB |
| | K3 | INT+CONBP+100%+WASH+ASB+OXY |
| | K4 | INT+CONBP+100%+WASH+ASB+XCOOK |
| | K5 | INT+CONBP+100%+WASH+AST+OXY+XCOOK |
| SULPHITE-MECHANICAL | | |
| | S1 | AST |
| | S2 | AST+GF |
| | S3 | AST+COAG |
| DEINKING/BOARD/FINE PAPERS/TISSUE | | |
| | F1 | ASB |
| | F2 | AST |
| | F3 | AST+COAG |
| | F4 | AST+GF |
| CORRUGATING | | |
| | C1 | AST |
| | C2 | AST+GF |
| | C3 | AST+COAG |

## Table 4.3
## REFERENCE PRODUCTION (1)
## RATES FOR COST ESTIMATES

| MILL | Total Production of Pulp and Paper (2) Average (3) (tonnes\day) | Reference (3) (tonnes\day) | Ratio | Bleached Kraft Production Average (3) (tonnes\day) | Reference (3) (tonnes\day) | Ratio |
|---|---|---|---|---|---|---|
| Boise (Ft. F) | 970 | 1,094 | 89% | 573 | 587 | 98% |
| CPFP (Dryden) | 965 | 1,258 | 77% | 735 | 915 | 80% |
| CPFP (T. Bay) | 2,290 | 2,584 | 89% | 1,279 | 1,540 | 83% |
| Domtar (Cnwall) | 726 | 856 | 85% | 412 | 480 | 86% |
| Domtar (R.R.) | 819 | 976 | 84% | 57 | 75 | 76% |
| Eddy (Espanola) | 943 | 1,216 | 78% | 943 | 1,216 | 78% |
| James River | 425 | 523 | 81% | 425 | 523 | 81% |
| K–C (Terr. B) | 1,110 | 1,308 | 85% | 1,100 | 1,308 | 84% |
| Malette | 298 | 390 | 76% | 298 | 390 | 76% |
| A–P (I.Falls) | 801 | 906 | 88% | | | |
| A–P (Ft. Will) | 371 | 428 | 87% | | | |
| A–P (Prov. P) | 424 | 489 | 87% | | | |
| A–P (T. Bay) | 472 | 517 | 91% | | | |
| Boise (Kenora) | 929 | 1,057 | 88% | | | |
| Q & O | 840 | 1,004 | 84% | | | |
| St. Marys | 506 | 629 | 80% | | | |
| Spruce Falls | 983 | 1,096 | 90% | | | |
| Domtar (Tren) | 327 | 382 | 86% | | | |
| MacMillan | 274 | 301 | 91% | | | |
| Beaver Wood | 225 | 347 | 65% | | | |
| Domtar (St. C.) | 161 | 196 | 82% | | | |
| Eddy (Ottawa) | 166 | 234 | 71% | | | |
| Noranda | 270 | 284 | 95% | | | |
| K–C (Hunts) | 100 | 118 | 85% | | | |
| K–C (St. C) | 108 | 114 | 95% | | | |
| Sonoco | 305 | 342 | 89% | | | |
| Strathcona | 178 | 217 | 82% | | | |

Source: McCubbin Consultants Inc. (1991)

(1) Reference production is the daily production rate that was exceeded on only 10% of the days the mill operated

(2) The sum of paper products plus pulp that leaves the mill

(3) Expressed in tonnes/day "as stated", for the first six months of 1990. Air Dry tonnes for bleached kraft pulp and machine dry for other products

each of the BAT Options postulated, **contaminant removal estimates presented are under-estimates and final loading numbers are over-estimates of the actual results.**

Initial loadings at each mill, listed in Appendix A, for the 5 indicator contaminants are recorded from the 12-month MISA monitoring period in 1990.

Because many different contaminants may be reduced by each BAT Option and because costs of BAT Options cannot be allocated to individual contaminants, contaminant loadings reduced could be summed in order to compare the costs and the results of one BAT Option with another and to conduct cost-effectiveness analyses.

Simple addition of the mass of contaminants being discharged or released (i.e. kg/year) imputes an equal weighting (i.e. weighting of 1) to each contaminant. However, some members of the subcommittee expressed concern over this procedure arguing that pollutants could only be aggregated if they were weighted in some manner.

Two potential contaminant weighting schemes were investigated:

1. The Copper Standard (developed by the US EPA) which provided weighting factors based on human and aquatic life exposure; and

2. Weights based on the Ontario Provincial Water Quality Objectives and Guidelines.

Application of weights derived from these standards were found to be ambiguous or inconsistent. Consequently, no weights have been applied in this assessment because all such schemes involve value judgements of the analysts or agency who choose and apply the weights and do not necessarily represent the views of other interested parties or the "public" as a whole.

Therefore, contaminant loadings are not weighted in this report and the absolute quantity loadings of various parameters are analyzed individually for comparative purposes and for computing cost-effectiveness.

Estimates of capital and operating and maintenance costs in 1991 dollars have been generated by McCubbin Consultants Inc (1992) for implementation of each BAT Option at each mill. The McCubbin estimates were compared with more accurate independent studies undertaken at individual mills and were found to be within +/- 20% of these values. The analysis to follow, use point estimates produced by McCubbin with the knowledge that they may be understated (or overstated) by as much as 20%.

Total costs of the various BAT Options at each plant must be compared and aggregated. However, one-time capital costs cannot be added to recurring (annual) operating costs unless certain adjustments are made. In this report, estimates of capital costs are **annualized** over a period of **10 years** at a **12% after-tax interest rate** and then multiplied by 1-T, where T is the prevailing effective corporate tax rate of 40%, to compute **"after-tax" annualized capital costs.**[2] After-tax annualized capital costs are then added to the **after-**

Table 4.4
INITIAL LOADINGS AND LOADING REDUCTIONS
For BAT OPTIONS
BY PROCESS CATEGEORY

| ABATEMENT OPTIONS | | CONTAMINANT LOADING REDUCTIONS TSS t/year removed | BOD t/year removed | AOX t/year removed | Phosphorus t/year removed | TKN t/year removed | COSTS CAPITAL $million | O&M $million/year | ANNUALIZED AFTER-TAX $million/year |
|---|---|---|---|---|---|---|---|---|---|
| KRAFT CATEGORY (9 MILLS) | | | | | | | | | |
| | Initial Loadings | 21,900 | 34,600 | 3,900 | 200 | 1,000 | | | |
| Options | | | | | | | | | |
| K1 | | 16,100 | 31,900 | 800 | 100 | (200) | 266 | 10.2 | 32.2 |
| K2 | | 16,300 | 32,000 | 2,700 | 100 | (200) | 326 | 19.7 | 46.4 |
| K3 | | 16,300 | 32,000 | 3,000 | 100 | (200) | 427 | 9.4 | 51.0 |
| K4 | | 16,300 | 32,000 | 3,100 | 100 | (200) | 770 | -15.6 | 72.4 |
| K5 | | 18,400 | 32,800 | 3,300 | 100 | (200) | 1,020 | 24.3 | 122.9 |
| SULPHITE/MECHANICAL CATEGORY (8 MILLS) | | | | | | | | | |
| | Initial Loadings | 11,900 | 63,800 | N/G | 50 | 270 | | | |
| Options | | | | | | | | | |
| S1 | | 10,000 | 62,800 | N/G | (20) | (610) | 198 | 25.7 | 36.5 |
| S2 | | 10,900 | 63,100 | N/G | 10 | N/A | 255 | 27.9 | 43.8 |
| S3* | | 10,900 | 63,100 | N/G | 10 | N/A | 238 | 33.6 | 45.4 |
| FINE PAPER\DEINKING\TISSUE CATEGORY (8 MILLS) | | | | | | | | | |
| | Initial Loadings | 1,300 | 3,600 | N/G | 2.7 | 70.4 | | | |
| Options | | | | | | | | | |
| F1 | | 700 | 3,200 | N/G | (7.3) | (119.6) | 31 | 4.0 | 5.7 |
| F2 | | 900 | 3,300 | N/G | (7.3) | (79.6) | 43 | 6.3 | 8.3 |
| F3 | | 1,100 | 3,400 | N/G | (7.3) | N/A | 57 | 6.8 | 10.2 |
| F4* | | 1,100 | 3,400 | N/G | (7.3) | N/A | 53 | 7.8 | 10.4 |
| CORRUGATING CATEGORY (2 MILLS) | | | | | | | | | |
| | Initial Loadings | 1,200 | 15,400 | N/G | 11.3 | 128.2 | | | |
| Options | | | | | | | | | |
| C1 | | 1,070 | 15,300 | N/G | 5.7 | 58.2 | 27 | 5 | 5.7 |
| C2 | | 1,130 | 15,350 | N/G | 8.1 | N\A | 33 | 5 | 6.4 |
| C3* | | 1,130 | 15,350 | N/G | 8.1 | N\A | 31 | 5 | 6.5 |
| TOTALS FOR THE PULP AND PAPER SECTOR (27 MILLS) | | | | | | | | | |
| | Initial Loadings | 36,300 | 117,400 | 3,900 | 264 | 1,469 | | | |
| COST EFFECTIVE | K2+S1+F1+C1 | 28,070 | 113,300 | 2,700 | 78 | (871) | 583 | 54.0 | 94.3 |
| MAXIMUM | K5+S2+F2+C2 | 31,330 | 114,550 | 3,300 | 111 | (280) | 1,351 | 63.3 | 181.4 |

() indicate loadings increase
N/A = No estimate made
N/G=Not Generated at this Mill
* Not least-cost, dropped from further analyses.
SOURCE: Best Available Technology for thr Ontario Pulp and Paper Industry
N. McCubbin Consultants Inc., Feb. 1992

## Table 4.5
## INITIAL AND FINAL LOADINGS FOR BAT OPTIONS BY PROCESS CATEGORY

| ABATEMENT OPTIONS | | CONTAMINANT FINAL LOADINGS TSS t/year | BOD t/year | AOX t/year | Phosphorus t/year | TKN t/year | COSTS CAPITAL $million | O&M $million/year | ANNUALIZED AFTER-TAX $million/year |
|---|---|---|---|---|---|---|---|---|---|
| KRAFT CATEGORY (9 MILLS) | | | | | | | | | |
| | Initial Loadings | 22,000 | 34,600 | 3,900 | 200 | 1,000 | | | |
| Options | | | | | | | | | |
| K1 | | 5,800 | 2,600 | 3,100 | 100 | 1,300 | 266 | 10.2 | 32.2 |
| K2 | | 5,600 | 2,600 | 1,200 | 100 | 1,200 | 326 | 19.7 | 46.4 |
| K3 | | 5,600 | 2,600 | 1,000 | 100 | 1,200 | 427 | 9.4 | 51.0 |
| K4 | | 5,600 | 2,600 | 800 | 100 | 1,200 | 770 | -15.6 | 72.4 |
| K5 | | 3,500 | 1,700 | 700 | 100 | 1,200 | 1,020 | 24.3 | 122.9 |
| SULPHITE/MECHANICAL CATEGORY (8 MILLS) | | | | | | | | | |
| | Initial Loadings | 11,900 | 63,800 | N/G | 50 | 270 | | | |
| Options | | | | | | | | | |
| S1 | | 1,900 | 1,000 | N/G | 70 | 880 | 198 | 25.7 | 36.5 |
| S2 | | 1,000 | 700 | N/G | 40 | N/A | 255 | 27.9 | 43.8 |
| S3* | | 1,000 | 700 | N/G | 40 | N/A | 238 | 33.6 | 45.4 |
| FINE PAPER\DEINKING\TISSUE CATEGORY (8 MILLS) | | | | | | | | | |
| | Initial Loadings | 1,300 | 3,600 | N/G | 3 | 70 | | | |
| Options | | | | | | | | | |
| F1 | | 600 | 400 | N/G | 10 | 190 | 31 | 4.0 | 5.7 |
| F2 | | 400 | 300 | N/G | 10 | 150 | 43 | 6.3 | 8.3 |
| F3 | | 200 | 200 | N/G | 10 | N/A | 57 | 6.8 | 10.2 |
| F4* | | 200 | 200 | N/G | 10 | N/A | 53 | 7.8 | 10.4 |
| CORRUGATING CATEGORY (2 MILLS) | | | | | | | | | |
| | Initial Loadings | 1,200 | 15,400 | N/G | 11 | 130 | | | |
| Options | | | | | | | | | |
| C1 | | 130 | 100 | N/G | 6 | 70 | 27 | 4.7 | 5.7 |
| C2 | | 70 | 50 | N/G | 3 | N\A | 33 | 4.9 | 6.4 |
| C3* | | 70 | 50 | N/G | 3 | N\A | 31 | 5.3 | 6.5 |
| TOTALS FOR THE PULP AND PAPER SECTOR (27 MILLS) | | | | | | | | | |
| | Initial Loadings | 36,400 | 117,400 | 3,900 | 264 | 1,470 | | | |
| COST EFFECTIVE | K2+S1+F1+C1 | 8,230 | 4,100 | 1,200 | 186 | 2,340 | 583 | 54.0 | 94.3 |
| MAXIMUM | K5+S2+F2+C2 | 4,970 | 3,650 | 1,000 | 153 | 1,350 | 1,351 | 63.3 | 181.4 |

N/A = No estimate made
N/G=Not Generated at this Mill
* Not least-cost, dropped from further analyses.
SOURCE: Best Available Technology for thr Ontario Pulp and Paper Industry
N. McCubbin Consultants Inc., Feb. 1992

**tax operating cost** to show a "typical" after-tax annual expenditure for the abatement program. Use of higher interest rates for annualization, where warranted, would increase the annualized cost of the capital component. Where T=0, a higher interest rate would be applied in the annualization formula to compute a higher, before-tax annualized total cost to reflect the higher before-tax return that firms require when investing funds. However, annualized cost figures shown below are after-tax estimates.

Wastewater flows and contaminant loadings are also a function of production of a particular plant. In order to produce comparable estimates of contaminant reductions and their costs for each technology train, a "reference" level of production has been postulated for each mill. These reference production rates are listed in Table 4.3 and an average of the daily production rate that was exceeded on only 10% of the first six months of 1990. Generally these reference production rates are the maximum capacity levels of output that can be achieved at each mill.

Based on the information provided in McCubbin (1992), it is presumed that each of the technologies and combinations used to develop cost estimates are of equal reliability.

For some mills, especially sulphate (kraft) mills, technologies that were expected to achieve loading reductions for BOD, TSS and AOX were also estimated to **increase** loadings of phosphorus and nitrogen. This trade-off occurs because nutrients are added during the operation of secondary effluent treatment processes in order to maintain an optimum microbial population for BOD removal.

## 4.3 Abatement Cost Functions

Estimates of costs and contaminant removals associated with each technology train or BAT Option are used to derive abatement cost functions for each plant in each process category. The cost functions consist of 5 points or levels of cost and contaminant removal achieved by the technology combinations for the sulphate (kraft) mills, 4 for deinking/board/fine papers/tissue mills and 3 points for mills in each of the other process categories.

Tabular and graphic cost functions show loading removals or final loadings per year of each contaminant associated with the annualized cost of each BAT Option. Cost functions for individual plants can be used to evaluate the potential cost implications of proposed limits for specific pollutants and other policy options. In this report, they are used to derive aggregate sector level cost functions based on specific decision rules. These aggregate cost functions provide cost estimates for the financial assessment of individual firms.

Three types of aggregate category cost functions may be derived:

- a simple summation of costs and removals of the same BAT Option applied at each mill;

- the cumulative, least-cost mix of BAT Options at each mill to achieve successively higher total levels of contaminant removal (or

lower levels of total final loadings) for the sector at the lowest total annualized cost; and

- the cost per unit of pollutant removed of each BAT Option for a category.

Abatement cost functions display only the least-cost combinations of technologies to achieve specific degrees of removal or final loadings. The analyses to follow show that some of the technology trains at certain mills reduce the same quantity of specific pollutants but at differing costs. Only least-cost BAT Options that achieve a given level of removal are used to derive plant-level cost functions which are subject to further economic and financial assessments.

## 4.4 BAT Options and Cost Estimates

The various combinations of technologies or "technology trains" that are postulated for each mill are listed in Appendix A along with their associated capital, O&M and annualized costs, and estimated contaminant loading reductions. Initial loadings and estimated final loadings for each mill are also contained in Appendix A.

Abatement costs vary from one plant to another because mills have different production processes, initial flow rates and effluent qualities. Consequently, the application of similar treatment technologies will yield different cost estimates at different mills because of site-specific differences in the ability to modify processes and the ability to adapt treatment systems to each mill. Moreover, if a mill has already implemented the technology concerned, or has achieved equivalent effluent quality, because of its inherent process and/or because of prior expenditures, it is shown as having a zero cost.

Category level aggregate capital, O&M and total annualized costs of each BAT Option are summarized in Tables 4.4 and 4.5. Table 4.4 displays the total initial contaminant loadings and reductions in these loadings for each process category. Table 4.5 presents initial loadings and final loadings for each category. Again, loading reduction and final loading estimates were produced for 5 contaminants for the sulphate (kraft) category and 4 contaminants for the other categories.

Figure 4.1 shows final loadings of each contaminant plotted against total annualized costs for each BAT Option or technology train for the sulphate (kraft) category (9 mills). Initial loadings for BOD, TSS, AOX, nitrogen and phosphorus are listed in the legend and displayed where the scale of the horizontal axis permits. These initial loadings are based on data collected during the MISA monitoring period, January 1, 1990 to December 31, 1990.

The 9 sulphate (kraft) mills currently discharge 22,000 tonnes of TSS annually, 35,000 tonnes of BOD, 3,900 tonnes of AOX, 200 tonnes of phosphorus and 1,000 tonnes of nitrogen. Based on the BAT Option K5, the maximum reduction of the listed contaminants that is technically achievable for kraft mills is 18,400 tonnes of TSS (84%), 32,800 tonnes of BOD (95%), 3,300 tonnes of AOX (85%) and 100 tonnes of phosphorus (50%). As

noted earlier, nitrogen loadings would increase under this option by 200 tonnes (20%) above current levels.

In terms of the ability to remove AOX, each BAT Option (K1 to K5) that can be applied to the sulphate (kraft) mills is least cost, to achieve a given amount of AOX removed. Technology train K5 represents the maximum removal of AOX at each plant and imposes the highest total annualized costs. However, this relationship does not hold for BOD or TSS. In terms of the ability to remove BOD, BAT Options K3 and K4 are not least cost. BAT Options K3 and K4 remove the same quantities of BOD or TSS from the category as does BAT Option K2 but at a significantly higher cost (See Table 4.4). This means that an aggregate category cost function for BOD or TSS would only include BAT Options K1, K2 and K5 but the aggregate cost function for AOX would include all five BAT Options suggesting that the BAT Options for the sulphate (kraft) category are designed primarily to reduce AOX.

Abatement cost functions for each plant in each category are displayed in Figures 4.2 to 4.11. For the sulphate (kraft) category, initial and final loadings of AOX are graphed against annualized costs for each plant and presented in Figures 4.2 and 4.3. At the mill level, these graphs indicate that all but one sulphate (kraft) mill (CPFP Thunder Bay) could reduce its AOX loading to between 100 and 200 tonnes per year with BAT Options K2 or K3. The CPFP mill at Thunder Bay could reduce its AOX loadings to about 300 tonnes per year by implementing BAT Option K3.

Figure 4.4 presents cost functions which graph initial and final loadings of BOD against annualized costs for each plant in the sulphate (kraft) category. It is clear from this graph that only two technical options exist for each mill that differ significantly in the reduction of BOD, namely K1 and K5. The same result can be seen in Figure 4.5 for TSS. Consequently, if TSS and BOD were the contaminants of chief concern from sulphate (kraft) mills, only the K1 or the K5 levels of abatement would be included in cost functions or would be considered for setting limits for these pollutants.

Each sulphate mill could reduce its annual loadings to about 1,000 tonnes of TSS and 500 tonnes of BOD by installing the least costly BAT Option K1 as shown in Figures 4.4 and 4.5.

Figures 4.6 to 4.11 present graphs of initial and final loadings of TSS and BOD against annualized costs for each plant in the sulphite-mechanical (8 mills), deinking/board/fine papers/tissue (8 mills) and corrugating (2 mills) categories. These graphs show that the largest incremental reduction of TSS and BOD could be achieved by adopting the lowest cost technology train. For these categories, the highest cost technology trains achieve no further reductions in TSS or BOD contaminant loadings than the lower cost second BAT Option. Moreover, phosphorus and nitrogen loadings are **increased** at some mills by these options due to the installation of biological effluent treatment.

As noted in Tables 4.4 and 4.5, option S3 for the sulphite-mechanical mills is not least-cost in reducing either BOD or

# ABATEMENT COST FUNCTIONS

Figure 4.1

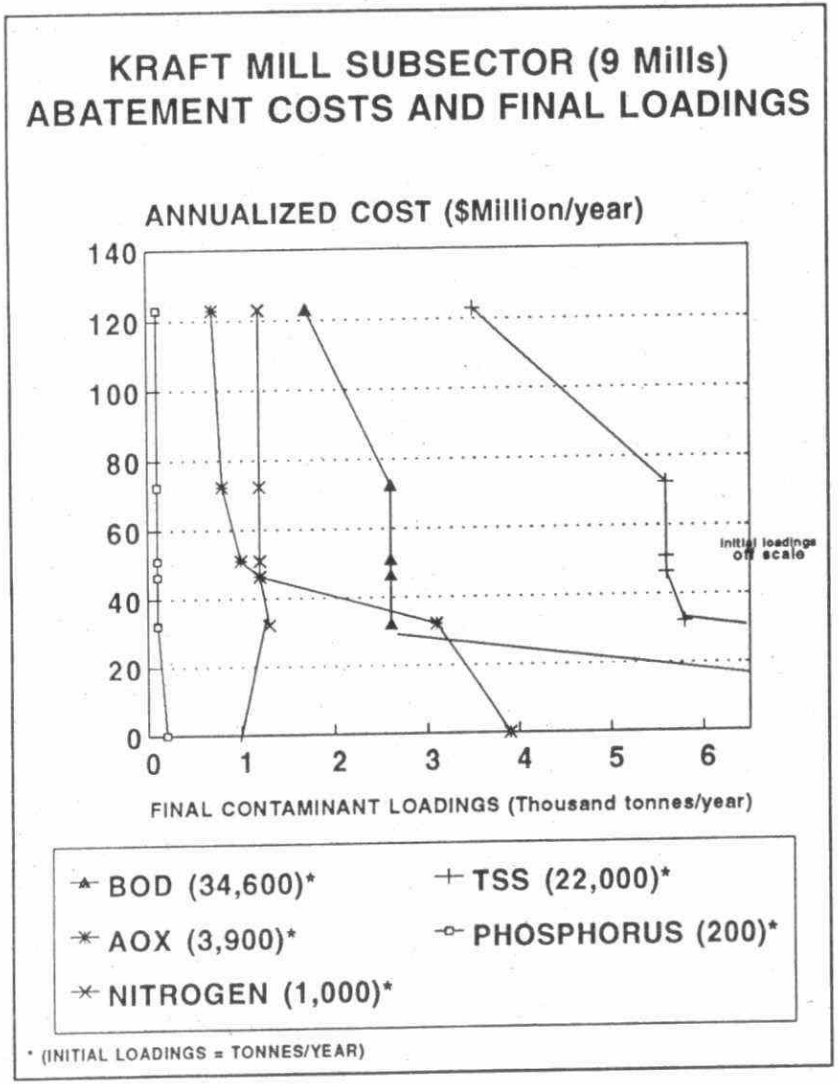
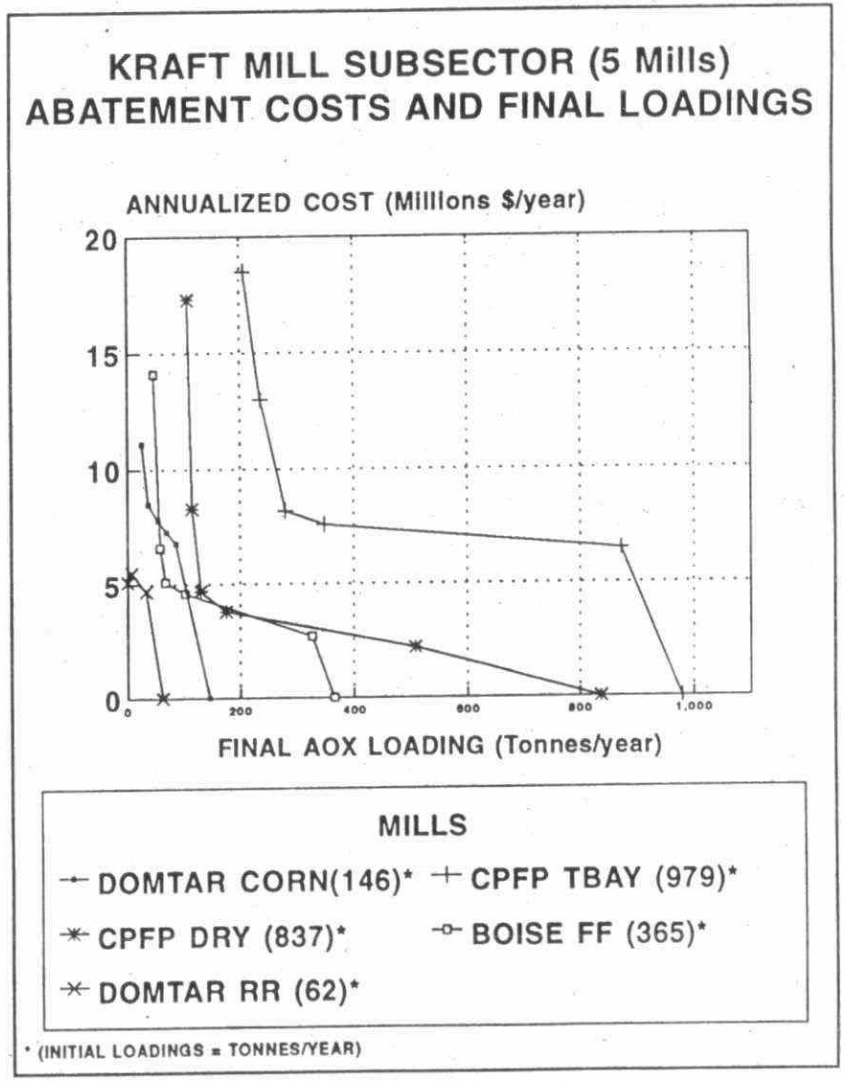



Figure 4.2



# ABATEMENT COST FUNCTIONS

Figure 4.3

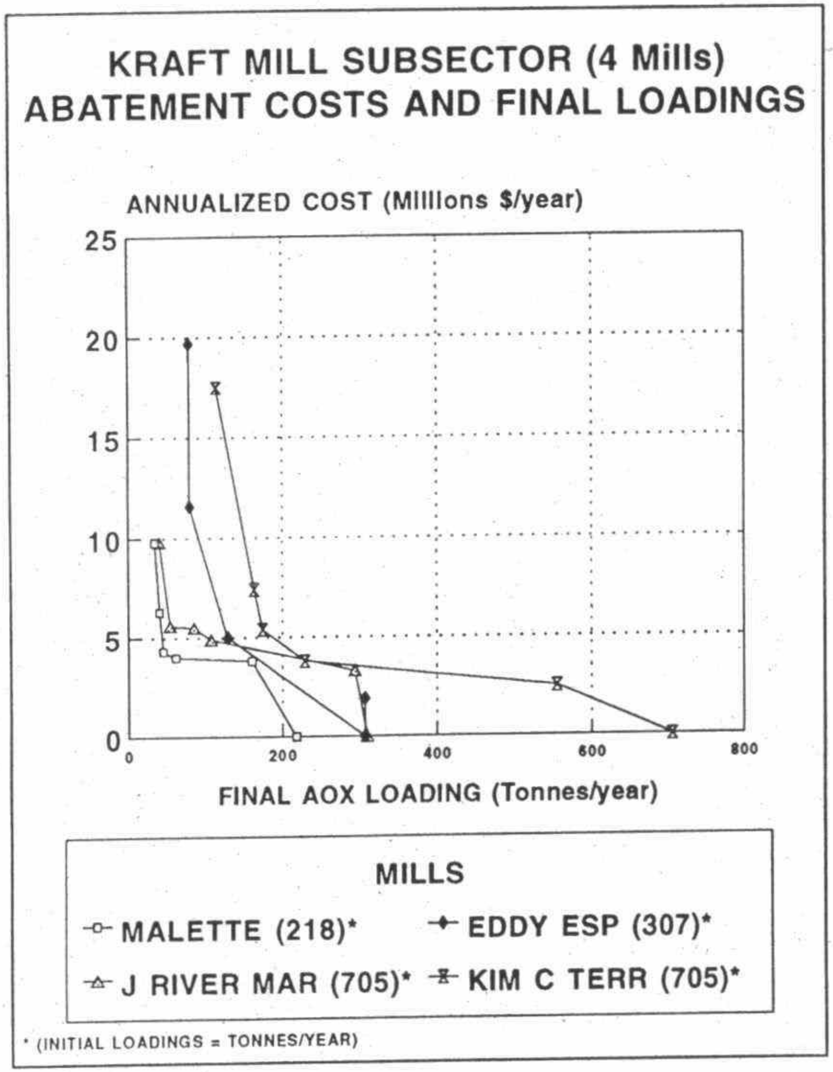
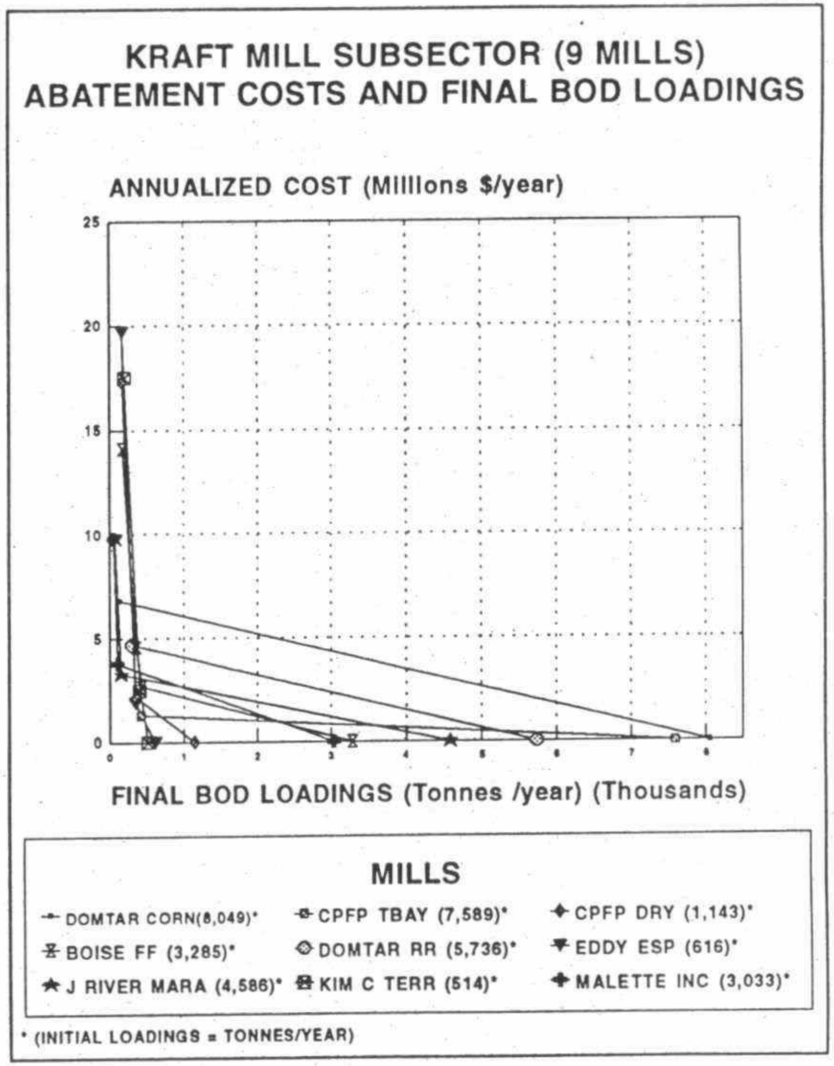



Figure 4.4



# ABATEMENT COST FUNCTIONS

Figure 4.5

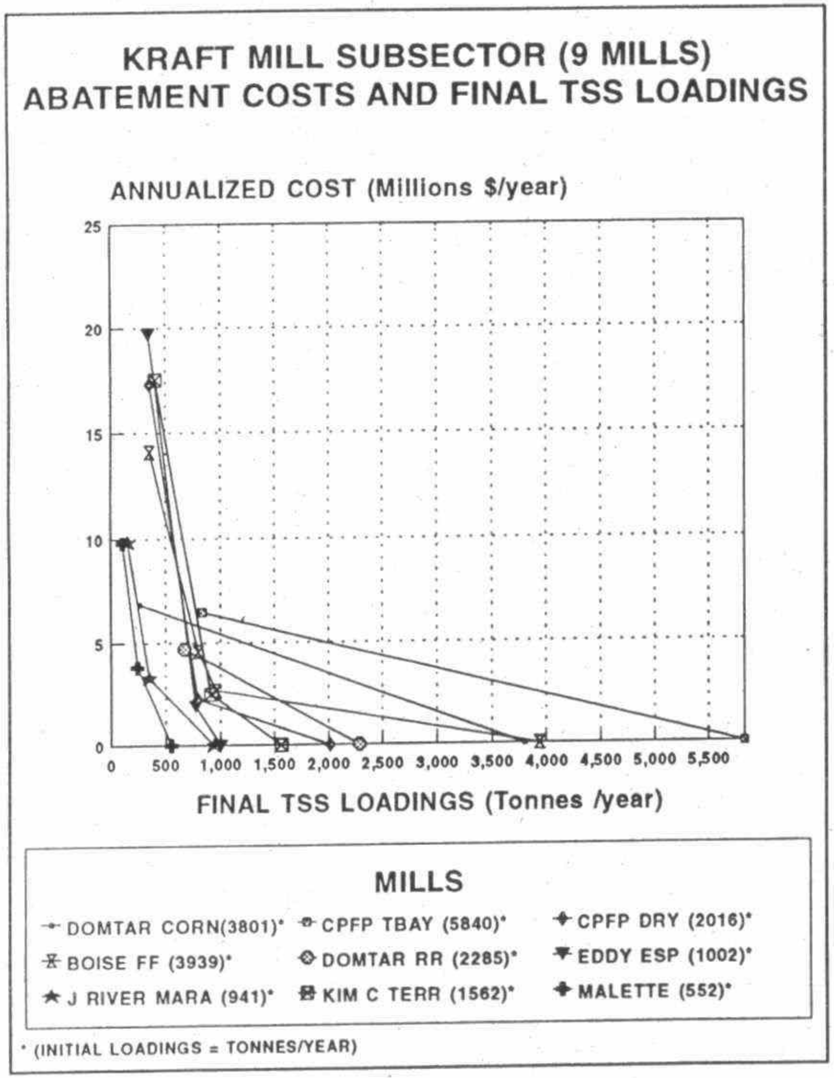
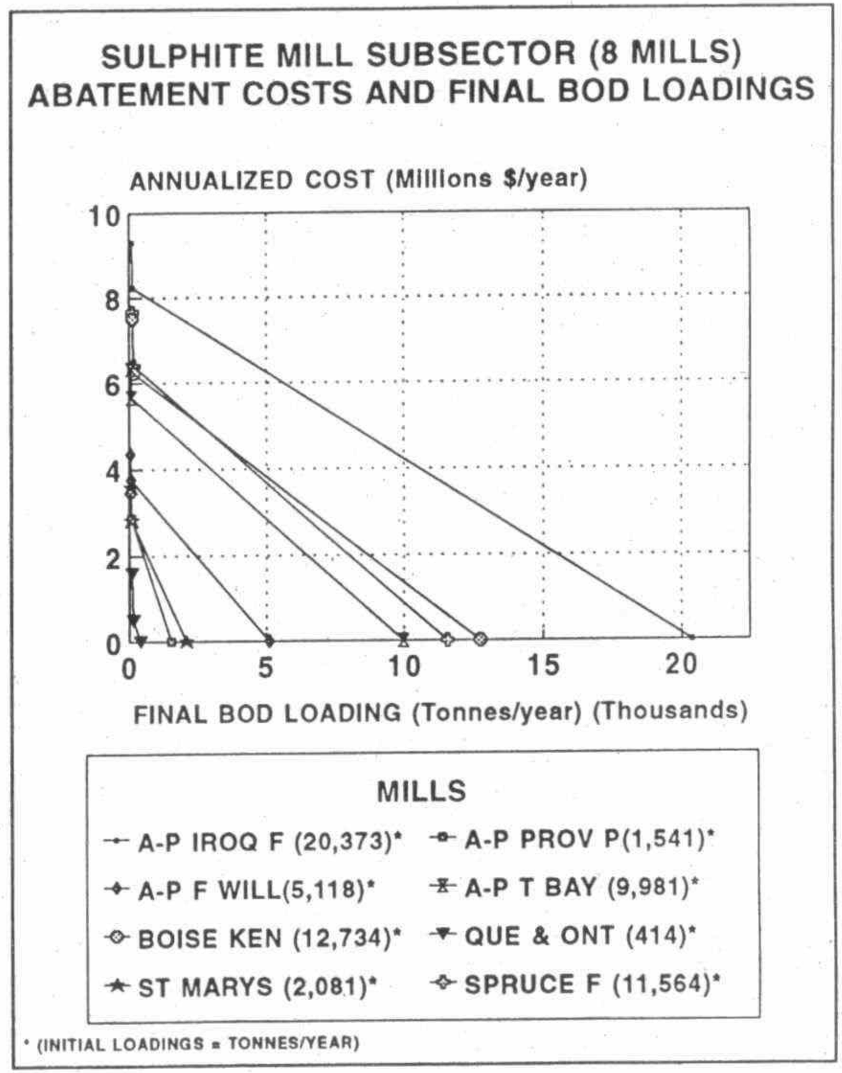


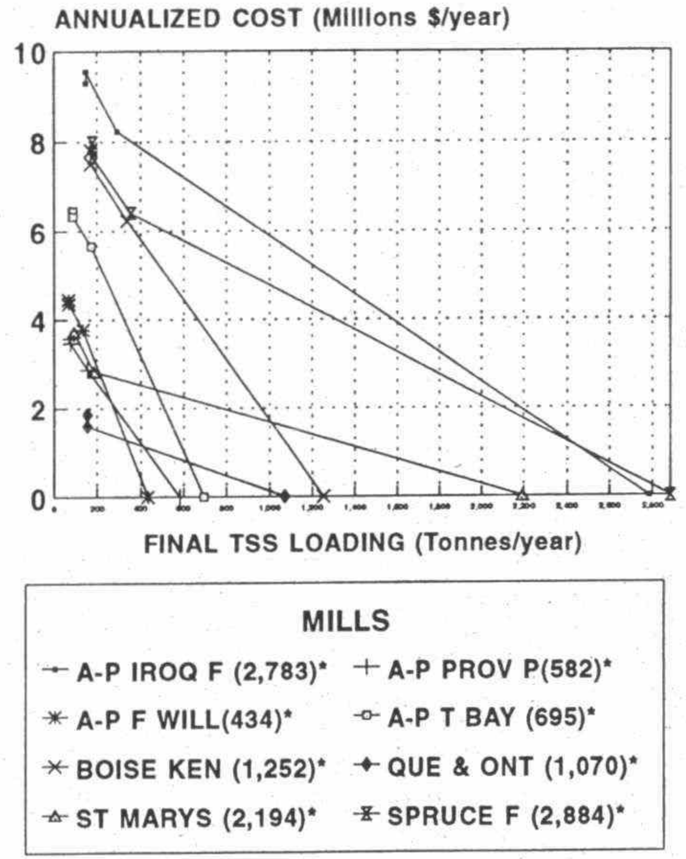

Figure 4.6



# ABATEMENT COST FUNCTIONS

Figure 4.7

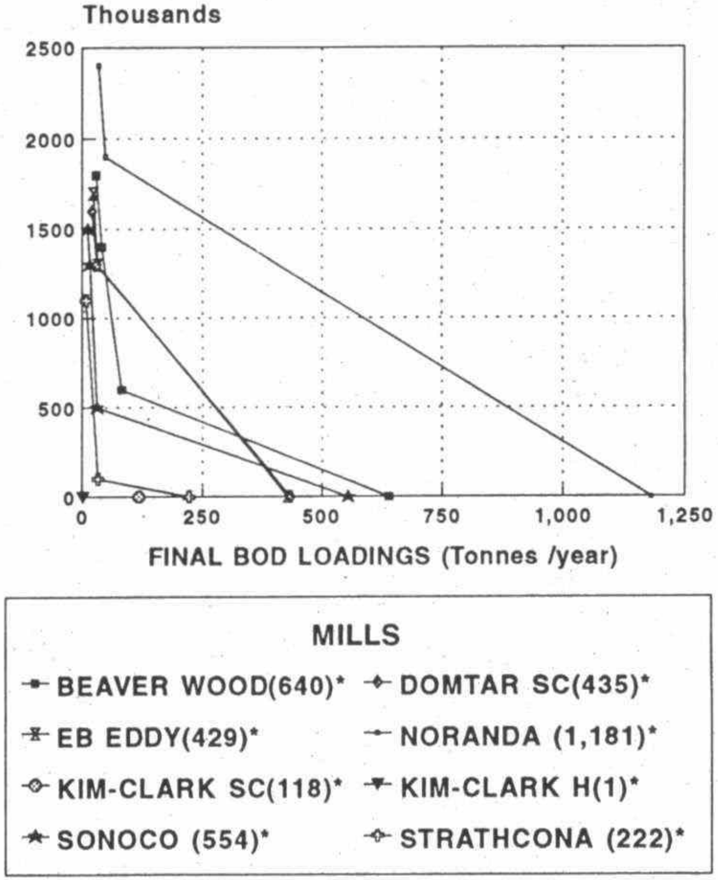
SULPHITE MILL SUBSECTOR (8 MILLS)
ABATEMENT COSTS AND FINAL TSS LOADINGS




* (INITIAL LOADINGS = TONNES/YEAR)

Figure 4.8

FINE PAPER/DEINKING/TISSUE/BOARD SUBSECTOR (8 MILLS)
ABATEMENT COSTS AND FINAL BOD LOADINGS




* (INITIAL LOADINGS = TONNES/YEAR)

# ABATEMENT COST FUNCTIONS

Figure 4.9

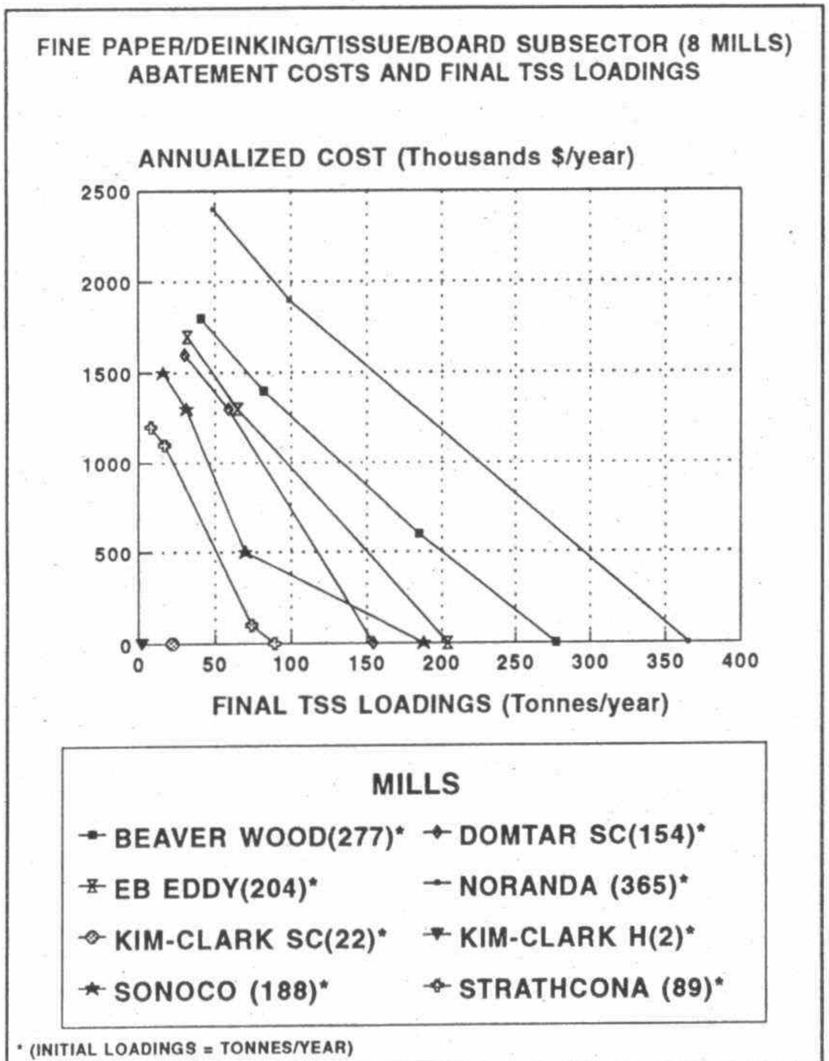
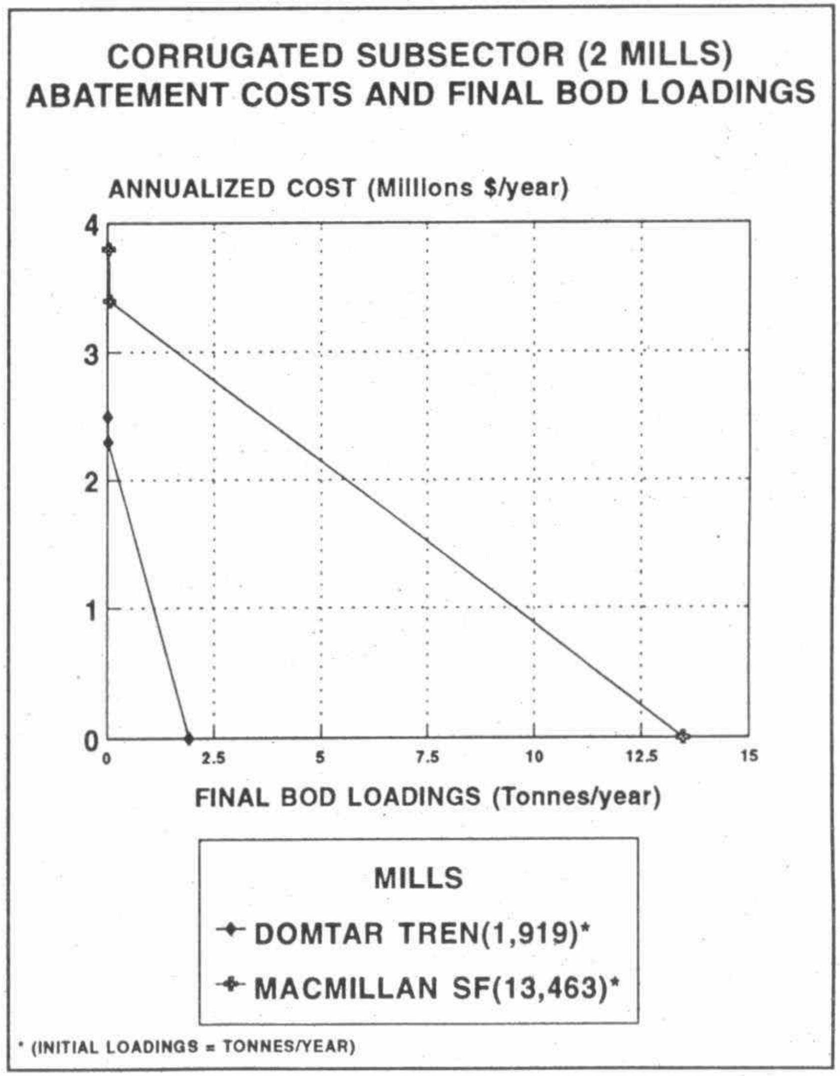



Figure 4.10



# ABATEMENT COST FUNCTIONS

Figure 4.11

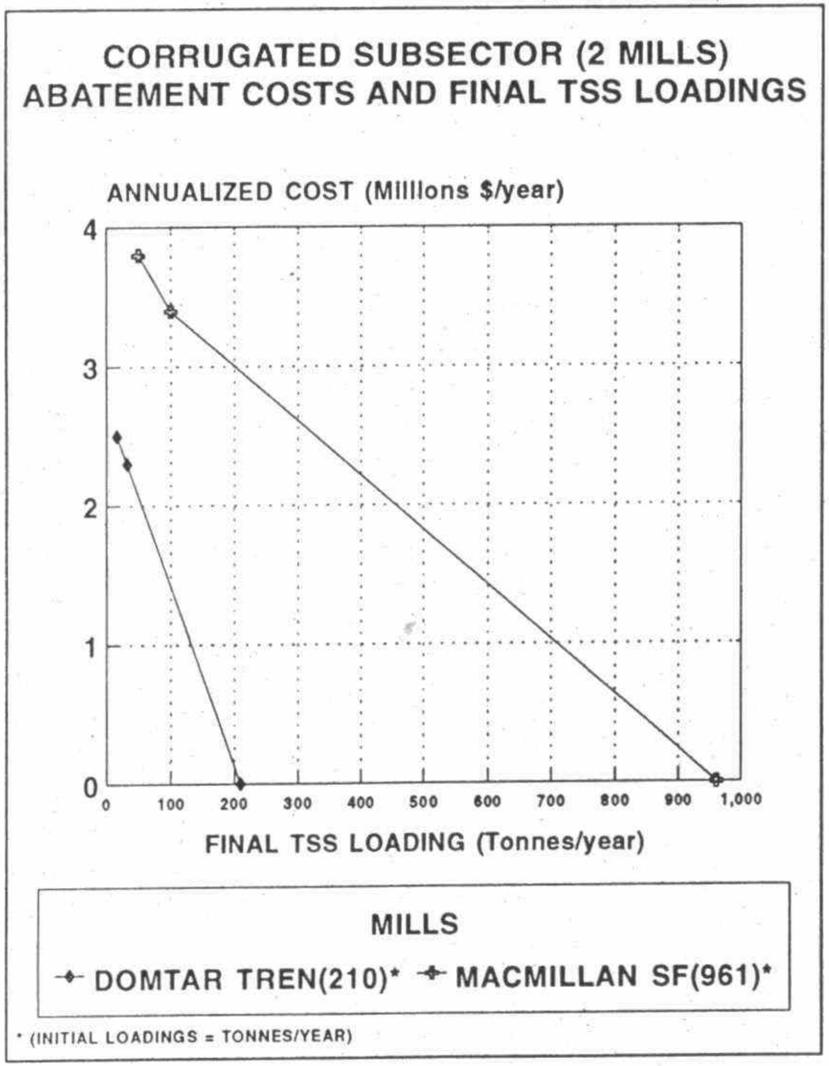
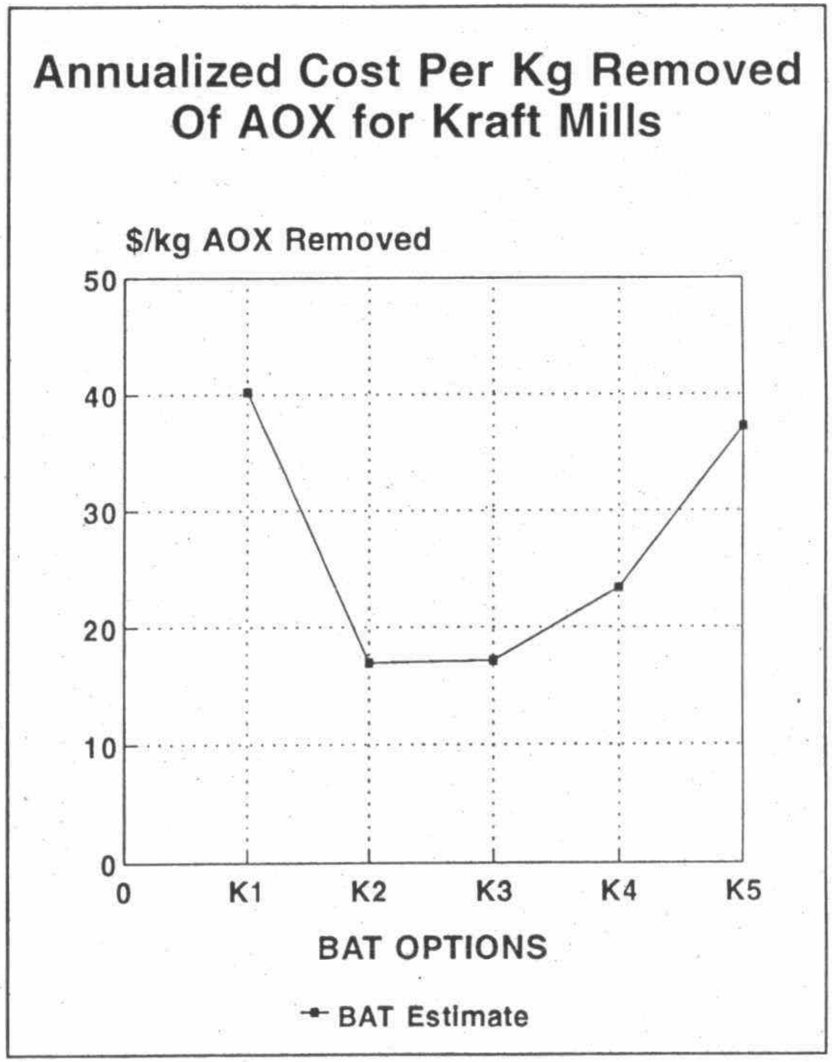



Figure 4.12



TSS in that it reduces the same amount of each contaminant as option S2 but at a higher cost (see chapter 2 for a discussion of least cost). For the deinking/board/ fine papers/tissue mills, options F3 and F4 are not least-cost in their ability to reduce BOD and option F4 is not least-cost in its ability to reduce TSS. For the corrugating mills, BAT Options C2 and C3 are not least-cost in reducing BOD and BAT Option C3 is not least-cost in reducing TSS.

The S3, F4, and C3 technology trains, as postulated for each of the categories, are clearly not least-cost because there would be no further reduction in TSS or BOD beyond what might be achieved by technology trains S2, F3 or C2 respectively. As a result, these options were dropped at the aggregate level and not subject to further analyses.

Note the large reductions associated with the first technology train in Figures 4.4 to 4.11. Alternative combinations of technologies exist to achieve lower loading reductions at each mill than that achieved by the first combination of technologies postulated by McCubbin however, these technologies did not meet the criteria of Best Available Technologies for the purpose of the MISA program and are therefore not discussed in this report.

## 4.5 Cost-Effectiveness of Abatement Options

Each of the remaining technology trains for each category is presumed to be the least-cost option to achieve the specified levels of contaminant removal, up to the level that the highest cost technology train is estimated to achieve. Thus, application of the BAT Options K5+S2+F2+C2 appears to be the "best available technologies" to achieve the **highest degree of contaminant removal technically achievable at least cost**.

These options could remove 85% of total AOX loadings, 98% of total BOD, 86% of total TSS and 42% of total phosphorus loadings discharged by the 27 pulp and paper mills subject to the MISA requirements. However, at the same time, these options might increase annual nitrogen loadings by 19%. From here on, this combination of BAT Options will be referred to as **the "Maximum Removal" scenario** for the entire sector. This scenario provides a benchmark level of cost and contaminant reduction which can be compared with other aggregate abatement scenarios.

A substantial number of combinations and permutations can be created from the remaining least-cost BAT Options. A decision rule is required to narrow down the number of options to be examined. One approach is cost-effectiveness analyses which aims to identify the lowest cost option to meet a single objective. The objective in this analysis is to identify the BAT Options which minimize the cost of removing each tonne of pollutant.

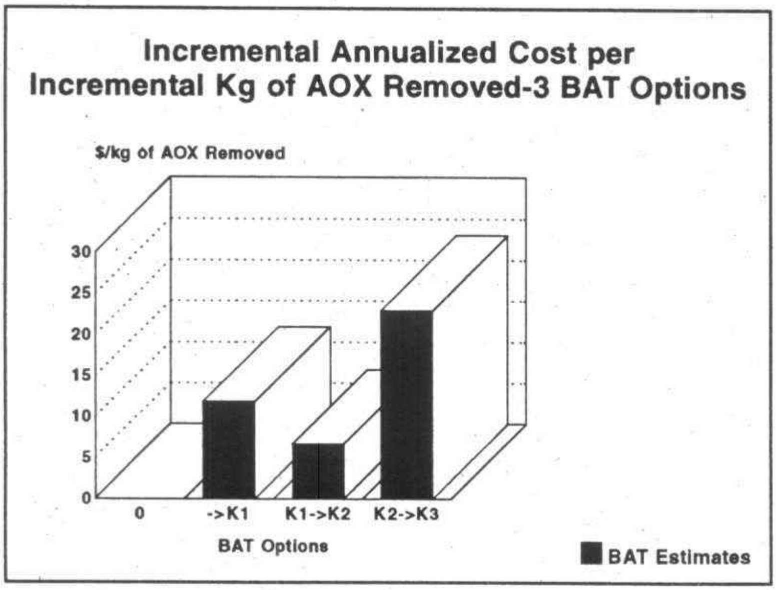
The cost per unit of pollutant removed (or average cost) is one measure of cost-effectiveness. Table 4.6 displays the annualized cost per kilogram of pollutant removed for each BAT Option and each contaminant. In the sulphate (kraft) category, Option K1 represents the lowest cost per kilogram removed for

BOD and TSS while, as indicated by Figure 4.12, K2 represents the lowest cost per kilogram removed for AOX.

For the sulphite-mechanical, deinking/board/fine papers/tissue and corrugating categories, BAT Options S1, F1 and C1 respectively are the cost-effective option based on average cost per unit of TSS and BOD removed. Least-cost BAT Options are ranked in Table 4.7 based on the average total annualized cost per kilogram of pollutant removed.

Another method of measuring cost-effectiveness is to calculate the average incremental cost per incremental unit of pollutant removed in achieving successively higher levels of reduction. Table 4.8 displays the incremental cost per unit of pollutant removed for each category. Option K2 is associated with the lowest average incremental cost for AOX. BAT Option K1 reduces 20% of the AOX in the sulphate (kraft) category at an average cost of about $12 per kg.

**Figure 4.13**




By undertaking BAT Option K2, the category achieves an additional 50% reduction in AOX at an average cost per kg removed of about $7. The average incremental cost per incremental kg removed of undertaking BAT Option K3 is about $15. This is a result of the small increase (8%) in removal efficiency attained by undertaking BAT Option K3 as compared with BAT Option K2. BAT Options K4 and K5 would impose very large average incremental costs per kg of AOX removed of $213 and $252 respectively. Figure 4.13 shows the average incremental annualized costs per kilogram removed of AOX for first three BAT options proposed for the 9 mills in the sulphate (kraft) category.

In all four categories, the first least-cost BAT Option for BOD and TSS represent the lowest average incremental cost. Relatively large average incremental costs are associated with the higher least-cost levels of pollutant removal.

Application of BAT Options K2+S1+F1+C1 in their respective categories would represent the most cost-effective scenario in terms of the lowest cost per kg removed of BOD, TSS and AOX. This combination of BAT Options and the resulting costs and removal estimates will be referred to as the **"Most Cost-Effective"** scenario in subsequent Chapters.

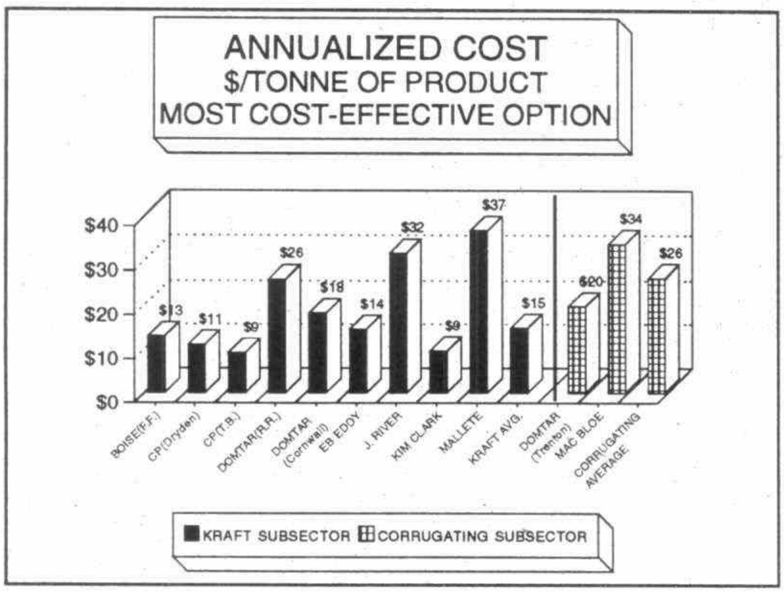
## 4.6 Distribution of Abatement Costs

Most Cost-Effective Option

The distribution of annualized cost per tonne of product is shown for each mill in Figures 4.14 and 4.15. The sulphate (kraft) category is the most important category in terms of total output accounting for about 54% of the total output of the province (see Table 4.3). Its share of the total annualized cost for the sector as a whole is approximately 50%. The average compliance cost in terms of annualized cost per tonne of output for the entire category (using the average 1990 production listed in table 4.3) is estimated at $15.

For the 9 mills in the sulphate (kraft) category of the industry four mills face compliance costs below the average for the category. The lowest cost mill incurs a cost of $9.10 per tonne of output. Five mills face costs higher than the average with three of these mills exhibiting costs more than twice the average cost per tonne of output for the category.

**Figure 4.14**

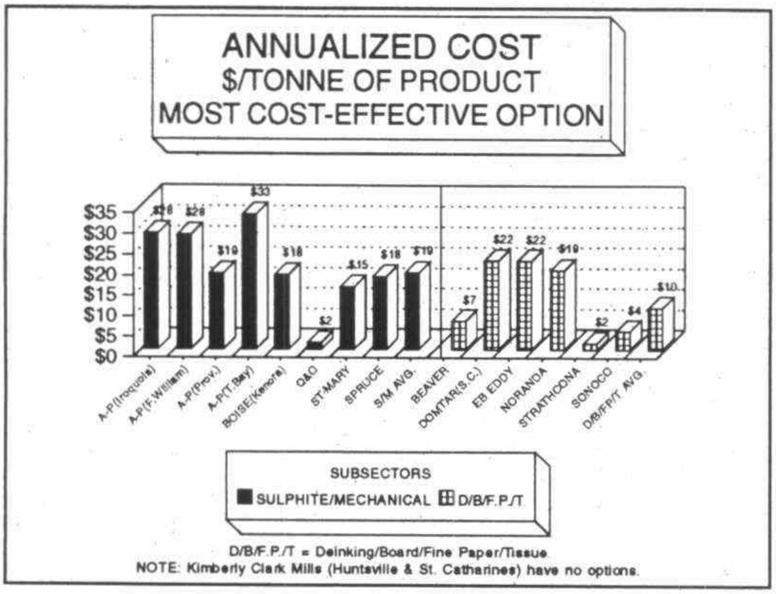



The eight mills in the sulphite-mechanical category account for about 33% of the total output for the 27 mills and would bear approximately 38% of the total annualized cost of the Most Cost Effective option. The average annualized compliance cost for this category is about $19 per tonne. Five of the eight mills face potential abatement costs below the average for the category while three mills face potential costs above the average. Annualized cost per tonne of output ranges from a low of about $2 at the Quebec and Ontario mill to a high of $33 at Abitibi-Price, Thunder Bay Division.

The deinking/board/fine paper /tissue category includes small scale mills which produce specialty products and account for only 9% of total output of the 27 mills subject to MISA. Of the eight mills in this category, two Kimberly Clark mills (Huntsville and St. Catharines) have no options defined for them and therefore face a zero cost. According to McCubbin, the Kimberly-Clark mills at St. Catharines and Huntsville already discharge effluent of better quality than attainable with the proposed technology trains due to improved white water management. Thus, this category would bear only 6% of the total industry cost. Three of the remaining six mills face potential costs below the average annualized cost per tonne of output of $10 while three mills face annualized costs above the average.

The corrugating subcategory is comprised of only two mills, one facing potential annualized costs of $20 per tonne of output while the other faces a potential

**Figure 4.15**




annualized cost of $34 per tonne of output.

## 4.7 Summary

McCubbin Consultants Inc. identified up to 5 abatement technology combinations for the 27 mills subject to MISA requirements. Technical removal estimates associated with the abatement technology combinations have been provided for four conventional pollutants and AOX.

The analyses reported in this chapter indicate that:

1) of five potential BAT Options available for sulphate (kraft) mills, each of the 5 BAT Options would achieve incremental reductions of AOX but only BAT Options K1 and K5 (the most costly level) would reduce TSS and BOD loadings;

2) for the remaining 16 non-kraft mills, McCubbin Consultants Inc. (1991) postulated only 2 or 3 options that are least-cost for the removal of TSS and BOD.

3) Nitrogen and Phosphorus loadings are reduced in some mills and increased in others due to the installation of biological effluent treatment systems.

Abatement cost-functions indicate that it would be possible for eight of the nine sulphate (kraft) mills to reduce annual AOX loadings below 200 tonnes per year per mill (from an average initial loading of 365 tonnes per year) by implementing the most cost-effective BAT Option K2 or K3 at each mill. Sulphate (kraft) mills could reduce their TSS loadings below 900 tonnes per year per mill (from a mill average of 2,400 tonnes per year) by implementing the least-costly BAT Option K1 but would also achieve large BOD and TSS loading reductions by implementing BAT Option K2.

Two measures of cost-effectiveness were computed for each mill and compared. These analyses indicate that the combination of BAT Options K2+S1+F1+C1 would be the most cost-effective scenario at reducing each tonne of BOD, TSS and AOX for the sector as a whole. To install this combination, the sector could incur a cost of $580-million in capital costs or $94-million annualized over 10 years and could achieve a 77% reduction in TSS, a 96% reduction in

BOD and a 70% reduction in AOX loadings. This Cost-Effective level of abatement may be compared with the larger cost Maximum Technically Achievable level of control which could cost the sector $1.3 billion in capital costs or $181-million annualized over 10 years. Application of these technologies are estimated to achieve reductions in TSS of 86%, BOD of 98%, and reductions in AOX of 85%.

## Endnotes to Chapter 4

1. According to the BAT Subcommittee, technologies are demonstrated if they satisfy the following criteria:

- technologies are utilized in the pulp and paper industry, or in similar applications producing comparable effluents;
- technologies can be retrofitted into at least some of the existing facilities;
- technologies have preferably been in commercial use for a significant time, one year;
- Design/sizing and costing information are available or can be developed; and
- Bench or pilot-scale technologies were considered in some cases of special interest.

2. The general annualization formula is:

$$TAC = O\&M \times (1-T) + K \times (r/(1-(r+1)^{-n})) \times (1-T)$$

| where: | | | |
|---|---|---|---|
| | TAC | = | Total Annualized Cost of Abatement |
| | O&M | = | Operating and Maintenance Costs |
| | T | = | Income Tax Rate |
| | K | = | Capital Cost |
| | r | = | (Real) Discount or Interest Rate |
| | n | = | Life of Abatement Equipment or System |

When T = 0, TAC represents the "before-tax" cost of the BAT Option which is also the cost to society; when T > 0, TAC represents the "after-tax" cost which is borne by the polluter.

The rate of interest used for the analyses is somewhat higher than interest rates being offered during the summer of 1992. If rates continue to remain at this level, annualized costs reported in this study may be over-estimated.

# 5.0 ABILITY OF THE ONTARIO PULP AND PAPER SECTOR TO INCREASE PRICES OR REDUCE FACTOR COSTS

*Available evidence indicates that prices of market pulp and newsprint are determined in competitive international markets. The current recession has forced both newsprint and pulp producers to reduce capacity utilization rates. The degree of competition found in product markets combined with the current recession indicate that Ontario market pulp and newsprint producers have little control over the price of their product.*

*Historically, domestic markets for paper and board products have been tariff protected and supplied by relatively few producers so that prices could be maintained well above cost levels incurred by Canadian producers. Cost increases at these mills could be recovered by steadily rising prices for these products. However, disappearing trade barriers allow increasing competition and have eroded firms' ability to impose price increases unilaterally for most paper products.*

*It is unlikely that individual Ontario firms could extract cost reductions from other input factors such as labour or raw materials. Modernization and capacity expansion investments may enable some firms to capture economies of scale and lower costs, but these possibilities are also uncertain at this time.*

## 5.1 The Potential to Increase Product Prices

The ability of a firm to control product prices depends on:

- the elasticity of demand for its products;
- the structure of the market it sells to and competes in;
- prevailing market demand conditions (i.e. growing or contracting);
- International trade barriers or the lack thereof; and
- capacity utilization.

How each factor contributes to or detracts from this ability is discussed below.

Demand for a product is price inelastic if, all other things held equal, a 1% increase in price leads to a less than 1% decrease in the quantity of that product consumed. Inelastic demand for a product allows the producer to increase prices in the short run without experiencing a decrease in revenue. As long as costs do not rise at the same time, the firm's profits will increase as well.

Price elasticity of Ontario paper products depends on the availability of substitutes and on the ability or willingness of consumers to reduce consumption of the good or service in question. The greater the extent that consumers of Ontario-made pulp and paper products can be served from other provinces in Canada and abroad, the more price elastic is demand.

The ability of Ontario mills to pass on cost increases as higher prices will be reduced by the extent to which mills outside of the province may be induced to enter and compete in markets traditionally served by Ontario producers. Moreover, the more Ontario output that is sold in other markets, the greater will be price elasticities of demand.

Important structural and organizational characteristics of an industry and its markets include the number of buyers and sellers and the market shares of the largest firms. If there are many buyers and sellers, and each firm controls only a small portion of sales or production capacity, i.e. less than 5 percent, no single firm can raise prices by its own actions. Such a market or industry is termed competitive and producers or consumers have little or no capability to set prices independently.

By contrast, if a small number of firms supply a given market, with one or two firms commanding a large portion of market shares (say 25% or more each) the situation is known as an oligopoly. Dominant firms in this type of market may have sufficient market power to set prices through "price leadership" or by tacit agreement amongst all competitors.

A market or industry dominated by a single supplier firm is monopolistic. Within limits imposed by demand conditions for the product or service in question (eg. price elasticity), the monopoly firm can set prices in that market. Monopoly producers have the greatest ability to pass on cost increases as higher prices but, depending on price elasticities, price increases can result in reduced demand for the monopolist's output.

Classification of a particular market or industry as competitive, oligopolistic or a monopoly depends on the number of firms currently involved in it. The fewer the number of suppliers to a market, the more concentrated it is and the greater the apparent ability of firms to recover increased costs by raising prices.

The Herfindahl Index is a measure of industry concentration that is defined as the sum of the squares of the market shares of each enterprise in an industry. An index value of 1 signifies a perfect monopoly where one firm controls 100% of the market share. A market with four firms each having equal market shares (25% each) would have a Herfindahl index of 0.25%. An index value close to 0 signifies a perfectly competitive industry which consists of many enterprises, each of which has an equal market share.

Statistics Canada (1986) reported a Herfindahl Index for shipments of about 0.05 for the Canadian pulp industry and a value of 0.09 for the more concentrated newsprint industry. By comparison, the automobile manufacturing sector, which includes Japanese and European firms as well as the North American "Big

Three", recorded the highest Herfindahl Index of 0.35. The Index for another relatively concentrated Canadian industry, iron and steel, was close to 0.2.

Another measure of industrial concentration is the percentage of total shipments made by the 4 largest firms in an industry (C4). The 4-firm shipments concentration for the Canadian pulp industry is 34.6% and for the newsprint industry is 48.8% as compared to the 46% weighted average for Canadian manufacturing industries as a whole (See Table 5.1). These index values imply that the Canadian pulp and paper industry has a relatively competitive market structure.

Moreover, because reported concentration indices do not include export markets and firms that import goods into Canada, the market structure for products such as market pulp and newsprint are even more competitive than indicated by concentration indices.

Prevailing market demand conditions include trends in the growth or decline in demand for a product, changes in technologies or product specifications and certain institutional arrangements. During periods of rising demand, firms generally have greater opportunities to initiate and maintain price increases. During periods of declining demand, producers are often obliged to cut prices in order to move product.

The introduction of new products or product specifications sometimes present opportunities for price increases or premiums. For example, writing papers containing secondary fibres brought a

**Table 5.1**

**Enterprise Concentration Measures**

**Concentration of Shipments of the Four Largest Firms (C4):**

| | **1983** | **1984** | **1985** | **1986** |
|---|---|---|---|---|
| Pulp Industry | 32.8 | 30.2 | 32.5 | 34.6 |
| Newsprint Industry | 58.4 | 49.6 | 48.9 | 48.8 |

**Concentration of Shipments - 1986**

| | **C4** | **C8** | **C12** | **C16** | **C20** | **C50** |
|---|---|---|---|---|---|---|
| Pulp Industry | 34.6 | 55.2 | 70.1 | 81.8 | 90.9 | 100 |
| Newsprint Industry | 48.8 | 73.1 | 88.7 | 97.1 | 100 | --- |

**Herfindahl Measures**

| | **Shipments** | **Value Added** | **Employment** |
|---|---|---|---|
| Pulp Industry | 0.0549 | 0.0578 | 0.0600 |
| Newsprint Industry | 0.0868 | 0.0864 | 0.1008 |

**Source**: Statistics Canada Catalogue 31-402

price premium as did metric sized writing papers that were used by the provincial government during the 1970's and 1980's.

Institutional arrangements that affect product pricing include tariffs and non-tariff barriers to international trade. These factors create a competitive advantage for domestic firms protected by tariffs or other barriers. As a result, barriers to trade diminish the number of participants in a market and increase the ability of the participants to pass on cost increases as higher prices.

Where the production of a product has reached its capacity limit, as measured by the capacity utilization rate, and demand continues to rise, the ability to increase prices is enhanced until increases in capacity are put in place. Conversely, when demand for a product falls sufficiently to cause one or more suppliers to drop out of a market, a temporary shortage of product may follow which soon disappears after prices increase and consumers adjust their purchases to the new price regime.

The greater the capacity utilization rate, the easier it is to increase prices.

Ontario pulp and paper mills sell both domestically and internationally to three primary markets: market pulp, newsprint, and paper products including fine papers and paperboard. In the remaining sections of this chapter each of these markets will be analyzed to determine the ability of Ontario producers to pass on pollution abatement and monitoring cost increases as higher prices.

## 5.2 Newsprint Markets and Prices

Price Elasticity

Singh et al. (1984) concluded that paper and paperboard prices were relatively stable during the 1950's and 1960's so that there was little consideration of the effect of price changes on demand. A perceived lack of substitutes for paper products contributed to the assumption, without extensive empirical testing, that price elasticities of demand for newsprint were very low.

In earlier studies, Gutherie (1972) and Schaefer (October 1979) found that newsprint demand was price inelastic: between -0.1 and -0.4 (ie. the quantity of newsprint demanded would decrease by between 0.1% and 0.4% for each 1.0% increase in price).

Singh et al. (1984) argued that during the 1970's, pulp and paper price increases constituted evidence that price elasticities of demand for newsprint could be increasing and that if this was the case, the issue required re-examination. Using a dynamic model framework with data between 1961 and 1982 that considered consumers' buying habits, inventories and expectations, Singh (1986) found the demand response for various grades of paper products was more elastic than previous studies had found. According to Singh, empirical long-run price and income elasticities were significantly higher than short run estimates, as would be expected. Singh concluded that newsprint and printing and writing papers were more price elastic than tissue, sanitary paper, wrapping paper and paperboard products which may be subject to more habitual

## Table 5.2

**Short-run and Long-run Elasticities of Demand for Paper and Paperboard Products**

| Products | Short-run Income Elasticity | Long-Run Income Elasticity | Short-run Price Elasticity | Long-run Price Elasticity |
|---|---|---|---|---|
| Newsprint | No significant results | | | |
| Printing and Writing Paper | 0.93<br>0.60 | 1.73<br>- | -0.89<br>-0.59 | -1.30<br>- |
| Tissue and Sanitary Paper | 2.28<br>0.56 | 3.02<br>- | -0.45<br>-0.37 | -0.88<br>- |
| Wrapping Paper | 0.43<br>- | -<br>- | -0.56<br>-0.69 | -0.89<br>- |
| Paperboard | 0.95<br>0.69 | 1.41<br>- | -0.77<br>-0.64 | -1.01<br>- |

Note: For each paper product, the top row shows elasticities based on a dynamic modelling framework, while the second row shows elasticities computed by a static model. Long run elasticities were not estimated with the static model.

Source: Singh and Nautiyal, "Adjustment Dynamics of Paper and Paperboard Consumption in Canada", Journal of Agricultural Economics, March 1986.

purchasing patterns and brand allegiance than other products and for which there are fewer substitutes. Singh's results, which are summarized in Table 5.2, indicate that newsprint and other paper products are still price inelastic.

### List and Transaction Prices

According to industry spokespersons prices for paper products include **list** and **transaction** or market prices. List prices are those "published" or announced by producers for specific products. Transaction or market prices are those that are actually realized and reflect discounts or premiums that are occasioned by market conditions. During periods of economic growth and rising demand, list and transaction prices tend to converge. However, during recessionary periods and soft markets as experienced during the last three years, list and transaction prices for newsprint have diverged with the latter falling as much as 31% below list prices, according to industry representatives.

Transaction price discounting has also been exacerbated by excess capacity in North American. North American newsprint producers installed five new paper machines in 1989, each having a capacity of 200,000 metric tonnes, with six more expected to start before 1992 (CPPA, 1991a, 1991d). Just one of these new paper machines has the same capacity as 2 or more machines in some Ontario mills. Under market conditions prevailing in 1991-92, not all of this new production can be sold without discounting prices or providing consumer incentives such as no transportation charge.

Wide price fluctuations are a characteristic of a capital intensive industry. Capital-intensive plants must incur large fixed costs regardless of the level of output at which they operate. Consequently, the more they produce, the lower their average costs. As long as product prices and total revenues of an individual mill are high enough to cover variable costs, each mill has an incentive to maintain as high a level of production as possible.

A dynamic pattern follows from this structural feature. During periods of growing demand, firms expand their capacity. This new production capacity must be added in discrete blocks so that total capacity may exceed quantity demanded when initially installed. Since each mill has an incentive to produce at full capacity, transaction price discounting may be necessary to sell the extra production. Discounting and other competitive behaviour serve to exacerbate otherwise modest price declines that may be initiated by cyclic demand contractions.

The bottom of the cycle is determined by the supplier with the **lowest** costs of production, called the "low cost supplier". The low cost supplier for a given product may be an Ontario mill or an importer. These low cost producers can raise prices to recover added abatement costs. Higher cost producers who incur extra abatement costs cannot raise prices by themselves without suffering reduced sales and reduced profits. Higher cost producers who continue to lose money in a low price environment may be forced to exit the industry thus reducing capacity to the extent that price discounts are no longer necessary to sell product. Prices, output and, eventually, capacity start to rise again and another boom cycle begins.

Newsprint is sold primarily by contract to newspaper publishers at **list** prices but, according to industry spokesmen, increasing quantities are sold as one-time transactions in spot markets. Over the past 2 years, Ontario producers have been selling product farther afield into regions not traditionally served. Higher transport costs to these customers have sometimes been absorbed by suppliers, over and above transaction price discounts of up to 31%, in order to promote sales.

It would appear that Ontario newsprint markets are becoming increasingly competitive with commensurately lower ability for individual firms or even regional industry subgroups to unilaterally increase prices. Nevertheless, as shown in Figure 5.1, current (i.e. not adjusted for inflation) newsprint selling prices have risen steadily since 1975 except for absolute declines in the recessions of 1983 and 1989-91. To the extent that regulation-induced cost increases incurred by all competing jurisdictions contribute to the secular trend in price increases, rising prices during periods of economic recovery may be able to offset at least part of regulation-induced cost increases.

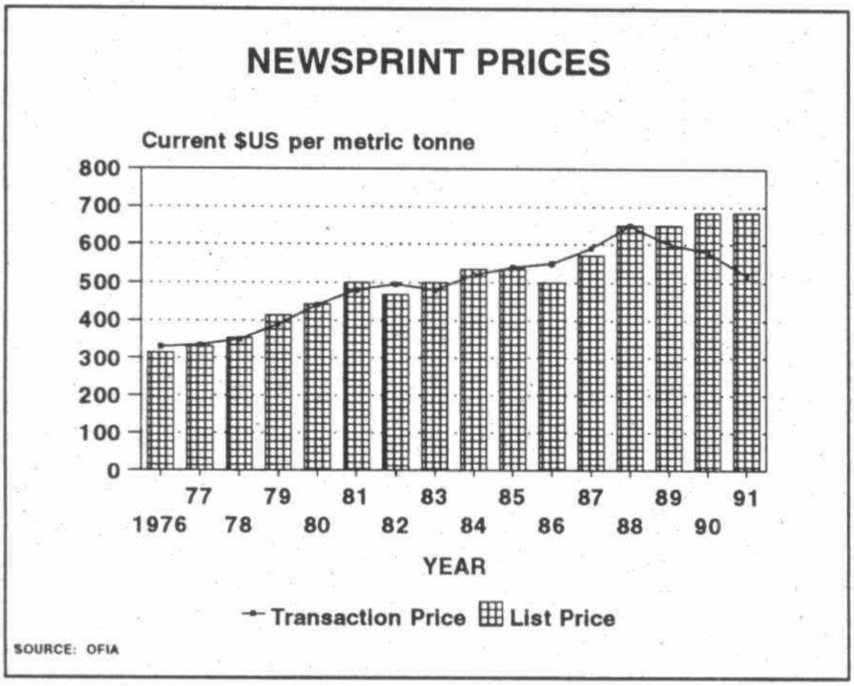
While proximity to markets may suggest that Ontario newsprint producers' domestic markets are secure, 90% of total newsprint production is exported to U.S. customers so that the Ontario newsprint industry is tied to the fortunes of the newspaper publishing interests of the United States. One would expect

that U.S. publishers will pay the lowest market price for newsprint. As noted in Chapter 3, new technology has prompted a number of major new mill installations in the U.S. South. These new mills tend to be the lowest cost operations which ultimately set newsprint prices and constrain the ability of higher cost Ontario mills to recover cost increases as higher prices.

As noted in section 3.3, Canada's market share of the U.S. in newsprint has dropped from 71 % to 50 % in the last 25 years. Ontario's share amounted to only 14% of the U.S. consumption in 1989. As Canada's and Ontario's share of the U.S. market shrinks over time, the ability of Canadian firms to affect the newsprint prices becomes less certain.

Capacity Utilization

Figure 5.1




Because new capacity for newsprint production requires several years to build, some producers were caught with new facilities and excess capacity just at the bottom of their business cycle. Six new newsprint machines were scheduled to start operating between 1990 and 1992, an 8.2% increase in Canadian capacity (CPPA, 1991). However, demand for newsprint was expected to decline by 6.1% in 1991 and increase by 2% in 1992 and 3% in 1993. This discrepancy between potential demand and supply capacity could result in the build up of large inventories or increased down-time for plants and machines. It could even mean closure of some high cost production facilities as has already occurred in Quebec and New Brunswick.

As shown in Table 5.3, newsprint capacity utilization rates for Canadian producers have fallen in recent years. As capacity utilization decreases, inventories rise, production is curtailed and down time is experienced at some mills.

Ontario newsprint producers are heavily dependent on U.S. markets which are subject to increasing competition from domestic and offshore suppliers. Furthermore, the current economic recession has forced Ontario mills to reduce capacity utilization rates. These market conditions reduce the ability of Ontario newsprint mills to pass on abatement costs as increased prices.

Table 5.3

**Capacity Utilization Rates for Newsprint Mills in Canada**

| 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| 96% | 99% | 98% | 96% | 90% | 87% |

Source: CPPA, Canadian Pulp and Paper Capacity

## 5.3 Market Pulp

While the pulp and paper industry as a whole is noted for its cyclical nature, pulp markets exhibit the most dramatic example of fluctuating prices as illustrated in Figure 5.2. A contributing factor to these wide oscillations is the tendency of producers with integrated mills to offer unused pulp for sale when demand for its own paper products softens thus increasing the supply of market pulp and depressing prices. For example, the price index for market pulp,shown in Figure 5.2, climbed steadily after 1978 and then fell sharply during the 1982 recession. After rising steadily since 1986, market pulp prices fell by 4.4% in 1990.

Transaction prices of bleached kraft pulp tripled during the 1970-1979 decade, reflecting

high production cost escalation and booming demand during the period. Although price levels levelled off throughout the early 1980's, price surges and subsequent downswings continued to characterize the market. The cyclic nature of this product market is depicted in Figure 5.2.

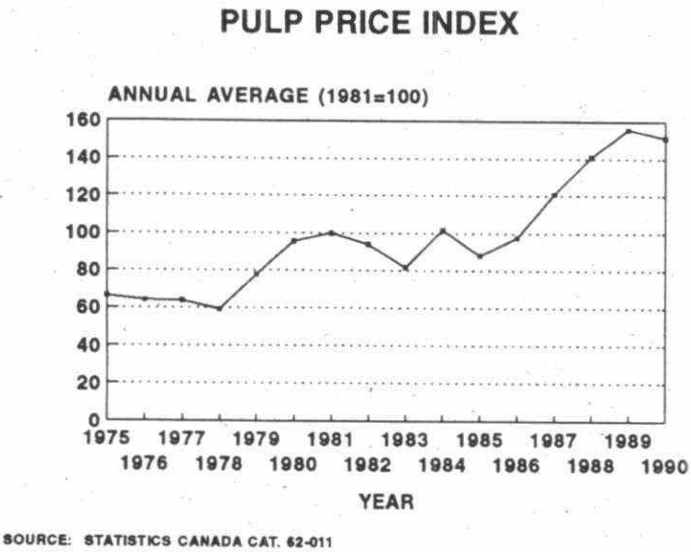
When world-wide demand for market pulp caught up with capacity in the late 1980's, the average bleached kraft pulp transaction price began to rise and peaked in 1989 at $823/ton (NLK - Celpap Consultants, 1991). Prices remained at these high levels for several years, which encouraged some customers to experiment with, and then switch to, lower-priced pulp grades. With pulp markets currently depressed and grade substitution spreading, bleached kraft pulp prices have fallen from the 1989 zenith to a list price of $500 during the summer of 1991 (The Globe and Mail, Nov.4/91, p. B1)

While demand for pulp and paper products grew rapidly during the latter half of the 1980's, several expansion projects were initiated. These facilities began operating in 1989 and 1990, increasing pulp capacity by 4.3% between 1989 and 1991 while shipments fell by 8.7% (CPPA, 1991c). As a consequence, Canadian pulp capacity utilization rates, which have been falling since 1987, as shown in Table 5.4, dropped to 84% in 1990 and further to 82% in 1991.

According to NLK Celpap Consultants (1991), Canadian bleached kraft pulp capacity is projected to increase by about 4.8% per year through 1994. However, demand for this type of pulp is expected to grow by an annual average of only 2.2% during this interval (NLK Celpap Consultants, 1991). These circumstances are likely to place downward pressures on market pulp prices over the next several years.

As noted in Chapter 3, about 42 Canadian kraft pulp producers currently

Figure 5.2




supply 32 percent of total world pulp exports. Furthermore, Ontario pulp mills compete with plants located in the United States, Finland, Sweden, Norway and, to a growing extent, plants in the former USSR (CPPA Reference Tables, 1990). Trade is stimulated by the absence of tariffs on wood pulp in the United States and Britain. These structural features are characteristic of a perfectly competitive market.

At present, capacity utilization rates for kraft pulp mills have been decreasing in response to soft demand for printing, writing and forms and packaging paper products and to increases in pulping capacity coming on stream. Canada's share of the U.S. market, Ontario's most important customer, has been shrinking. Furthermore, high prices in the 1980's led customers to seek substitutes for bleached kraft pulp, Ontario's primary pulp product.

Table 5.4

**Capacity Utilization Rates for Pulp Mills in Canada**

| 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
|---|---|---|---|---|---|
| 91% | 95% | 95% | 92% | 84% | 82% |

Source: CPPA, Canadian Pulp and Paper Capacity

Market pulp prices rise only during periods of economic recovery, rising demand and/or when most or all producers incur similar cost increases, This price behaviour is characteristic of a competitive market. These conditions were apparent in 1988-89 when market pulp price increases were sustained.

In November of 1991, lower inventory levels and rising shipments in the month of September prompted 3 of Canada's largest softwood pulp producers, Canfor Corp., Fletcher Challenge Cda Ltd. and Western Forest Products Ltd. all based in Vancouver, to raise list prices of pulp by between $US 15 and $20 a tonne for hardwood pulp, while premium-grade softwood pulp prices were increased by $20 December 1 (The Globe and Mail, Nov.4/91, p.B1). Ontario firms soon followed suit.

The evidence indicates that prices of market pulp are determined in competitive international markets. Along with newsprint producers, the current recession has forced pulp producers to reduce capacity utilization rates. These factors imply that Ontario market pulp

producers have little control over the price of their product.

## 5.4 Fine Papers, Paperboard and Other Products

Paper products, other than newsprint, enjoyed Canadian tariff protection in the past (Donnan and Victor (1976)). Moreover, there were relatively few Canadian suppliers of these product markets in Canada. Consequently, Canadian fine paper and board producers of these products directed their output primarily to domestic markets. In contrast to market pulp and newsprint, the market structure for most other paper products has been more concentrated and favoured conditions under which Canadian producers could pass on cost increases relatively quickly as higher prices for these products.

However, Canadian tariffs for many paper products have been reduced or removed under GATT or the US-Canada Free Trade Agreement (FTA). As a result, consumer and industrial paper products face increasing competition from imports, particularly from U.S. firms whose plants enjoy greater economies of scale than Canadian mills. Moreover, paper products increasingly are sold to large industrial or retail buyers who have access to imports and who are able to negotiate lower prices. As a result, Ontario firms face increasing competition in domestic markets for fine papers and boards. On the other hand, the FTA opens market opportunities to Canadian and Ontario producers which can allow larger production runs and associated cost savings from economies of scale.

Historically, domestic markets for paper products have been tariff protected and supplied by relatively few producers so that prices could be maintained well above cost levels incurred by Canadian producers. Cost increases could be recovered by rising prices. However, disappearing trade barriers permit increasing competition and has eroded firms' ability to effect unilateral price increases for most paper products.

## 5.5 Ability To Change Input Prices

In some situations, firms may be able to reduce the costs or prices paid for certain input factors such as labour, chemicals or other supplies. This may be feasible for those inputs for which individual pulp and paper plants or firms are single buyers and have monopsony power. For example, a mill may be the only buyer of wood in a particular locality and may be able to dictate prices paid to loggers.

In 1990, the latest year for which data are available, the Ontario pulp and paper industry employed approximately 17,000 people, accounting for over one quarter of all pulp and paper mill employment in Canada. In Northern Ontario pulp and paper mill locations, mills directly employ a quarter to a third of the community labour force.[1] Currently, the northern communities of Dryden, Fort Frances, Kenora, Espanola, Iroquois Falls, Kapuskasing, Marathon, Red Rock, Smooth Rock Falls and Terrace Bay depend almost exclusively on pulp and paper mills for employment opportunities.

In these communities, the monopsony position of the mills as a buyer of labour would appear to enable firms to extract

wage reductions or to at least curtail wage increases. However, because mill workers are unionized, wage adjustments are generally confined to contract negotiation periods. While wage and benefits concessions have been agreed to by unions during periods of economic downturn, it is unlikely that any single company would be able to extract cost reduction on their own at specific mill sites.

In conclusion, under current economic conditions and market structures, the ability of Ontario pulp and paper mills to impose unilateral price increases on any of its product lines is severely limited in the short run. However, over the medium or long run, market conditions could permit price increases to recover abatement costs as the economic recovery takes hold and as demand for paper products increases.

It is unlikely that individual Ontario firms could extract off-setting cost reductions from other input factors. Modernization and capacity expansion investments may enable some firms to capture economies of scale and lower costs but these possibilities are uncertain at this time.

## Endnotes to Chapter 5

1. According to the Ontario Forest Industries Association, Northern Ontario pulp and paper mills account for nearly one job of every three manufacturing jobs and approximately 74% of that region's economy is dependent on the forest industry (OFIA, 1991).

# 6.0 FINANCIAL ASSESSMENTS AND IMPACTS OF BAT OPTION COSTS ON PULP AND PAPER FIRMS

*Potential regulatory costs were compared against sector and company financial performance for six firms (which own 14 mills in Ontario) recorded over the past 10 years and the most recent year (1990). Costs associated with the Most Cost-Effective (MCE) and the Maximum Removal (MAX) configurations of abatement cause very similar effects on firms that were profitable. Effects on financial indicators (eg. net income, return on capital, cash flow, debt to asset ratio) ranged from no change in some financial indicators to a 19% reduction (decrease of $17 million) in net income at one firm.*

*For those firms that incurred losses during 1990, the costs of achieving the Most Cost Effective level of abatement (MCE) could cause reductions in 1990 cash flow of 6% to 112% and could impose a 4% to 200% increase in firms' 1990 net losses. For the same firms, the Maximum Removal level of abatement (MAX) could cause reductions in 1990 cash flow of 7% to 125% and could impose a 4% to 700% increase in 1990 net losses.*

*In the short term (1-3 years), both options exacerbate the poor financial results experienced during the early 1990s. The MAX option costs have a much larger effect on the financial position of the firms analyzed than do those of the MCE option. The MAX removal option could cause an immediate reduction in cashflow and assuming debt financing, add pressure on the firms' currently strained ability to borrow funds. The results of the analysis indicate that the MCE option would do much less to exacerbate current poor financial results among the firms analyzed.*

*In the longer term, impacts on average 10-year financial performance were small for both the MAX and MCE options. If economic recovery returns annual profit levels to the 10-year average, sector firms would experience only small changes in their financial performance under either the Most Cost Effective or the Maximum Removal BAT Option configurations.*

## 6.1 Introduction

The financial and economic implications of potential MISA-related abatement costs are analyzed in this Chapter, assuming that all potential water pollution abatement and monitoring costs will be absorbed by the regulated firms. MISA-related costs are added to past financial performance data for the pulp and paper sector to determine the changes in relevant financial measures and indicators.

Consistent with the draft <u>Issues Resolution Committee Report</u> (June 1990), financial performance data over the past 10 years are used to assess the potential financial effects of the relevant monitoring and abatement costs for the constituent firms or for individual mills.

Comparisons of potential MISA-related compliance costs with expected **future financial performance indicators** constitutes one approach with which to judge the effects of potential regulatory costs. This analytical approach could not be implemented for the pulp and paper sector because agreed to financial performance forecasts for individual plants or firms are difficult to produce with any degree of certainty or reliability and furthermore, are not available from independent sources.

Analyses presented in this chapter are based on published data from Statistics Canada and the consolidated financial reports of each company. From a public policy perspective, assessments of the implications of increased regulatory costs at the firm and the industry (or sector) level are important and useful for the following reasons:

a. Intra-firm transfer prices (that are charged to one division of a firm by another division of the same firm) for a particular plant may not reflect true market conditions (i.e. prices that a pulp mill receives from paper mills owned by the same company may be below fair market prices);

b. Corporate resources may be available that are not recorded in plant level income statements; and,

c. The firm, rather than the plant, would have to raise the funds for implementing regulatory requirements.

However, consolidated, firm-level financial data may not accurately represent individual plants because these data include revenues and costs of different business units (i.e. some pulp and paper companies also manufacture forest and building products, and operate supermarket chains) and of different plants and facilities operating outside of Ontario. Consequently, analyses using plant level financial data in addition to company level financial statistics would provide the best overall assessment of financial impacts.

Plant level financial data however, are not available for analysis. Moreover, only those firms for which the Ministry has complete, published financial data for the years 1981 to 1990 were subject to analysis in this chapter.

Financial analyses are performed by adjusting or "shocking" **historical financial indicators and ratios** with the relevant MISA-related costs (and revenues, if any) to determine how each indicator would have changed if the costs would have been incurred during the relevant time period.

Insights from financial statements are based on relationships between items on the statements (i.e. creating ratios, percentages) and on trends in these relationships or specific financial indicators (comparative time-series

## Table 6.1
## Actual and Estimated Monitoring Costs For Mills Subject To MISA Requirements

| Mill | Monitoring Costs | |
|---|---|---|
| | Total Capital ($'s) | Total Operating ($'s) |
| Boise Cascade (Fort Frances) | 230,000 | 243,700 |
| CPFP (Dryden) | 211,000 | 242,300 |
| CPFP (Thunder Bay) | 208,000 | 245,600 |
| Domtar (Cornwall) | 303,000 | 223,700 |
| Domtar (Red Rock)* | 1,241,000 | 170,000 |
| Kimberly-Clark (Terrace Bay) | 3,000 | 228,500 |
| E.B. Eddy (Espanola)* | 60,000 | 107,330 |
| James River* | 54,900 | 79,000 |
| Malette* | 4,300 | 76,500 |
| Abitibi-Price (Iroquois Falls)* | 142,600 | 55,000 |
| Abitibi-Price (Ft. William)* | 92,000 | 43,500 |
| Abitibi-Price (Provincial Papers) | 48,700 | 169,400 |
| Abitibi-Price (Thunder Bay)* | 41,000 | 91,000 |
| Boise Cascade (Kenora)* | 33,300 | 59,000 |
| Spruce Falls* | 73,000 | 76,700 |
| Quebec and Ontario | 178,000 | 163,000 |
| St. Marys | 183,000 | 166,400 |
| Beaver Wood* | 14,000 | 46,500 |
| Domtar (St. Cath)* | 40,100 | 28,700 |
| Kimberly-Clark (Huntsville)* | 16,400 | 134,700 |
| Noranda* | 38,700 | 95,500 |
| Sonoco* | 7,300 | 38,760 |
| Strathcona* | 62,000 | 61,800 |
| E.B. Eddy (Ottawa) | 3,000 | 158,400 |
| Kimberly-Clark (St. Catharines) | 121,000 | 158,600 |
| Domtar (Trenton)* | 425,000 | 48,200 |
| Macmillan Bloedel* | 120,300 | 93,100 |
| Total | $4,864,906 | $3,480,180 |

Source: MISA Actual Monitoring Questionnaires
Ontario Ministry of the Environment (August 1989) Monitoring Cost Estimates and Their Implications for Direct Dischargers in the Ontario Pulp and Paper Industry
* indicates Actual costs

analysis). Incremental regulatory costs may be added to financial statements to determine how ratios, percentages and absolute values of historical financial indicators would change and by what magnitude. While such an approach is useful, several caveats are in order.

First, as noted, financial statements are records of the past. Historical information is frequently used in decision-making. A critical assumption is that future financial performance will on average be similar to historical trends.

Second, ratios and trends serve as "red flags" regarding problem areas. While ratio and trend analyses help identify past and present financial weaknesses of a company, they do not necessarily reveal the underlying cause of the results.

Finally, a single ratio by itself does not fully characterize a firm's financial performance just as a single pollution parameter may not accurately represent water quality. Moreover, it is often not possible to judge the relative importance of a given value of a ratio or financial indicator or specific changes in these values. Therefore, an inventory of financial indicators and ratios is needed to fully gauge a firm's financial performance. Furthermore, benchmark or threshold values can be defined against which financial indicators can be compared in order to judge and evaluate the importance of specific changes. Thresholds may be based on industry averages, on historical results of a particular firm or of competitors or on planned performance levels.

Most firms that own and operate pulp and paper mills in Ontario are major, national and multi-national corporations so that small business interests are not at stake in this sector.

## 6.2 Financial Indicators and Thresholds

Effects of incurring the costs associated with the MISA monitoring regulations were evaluated on the basis of changes to three financial indicators: **after-tax return on investment or capital employed, capital investment and after-tax profits** (Ontario Ministry of the Environment, August 1989). These costs are presented in Table 6.1.

After-tax return on investment or capital employed was used because it represents the return that induces owners and investors to keep their capital in a particular enterprise or if returns drop low enough, to move their money to another business that may be more profitable.

Incremental operating costs as a percent of after-tax profits shows the amount that these profits could be reduced by the regulatory requirements. Similarly, the incremental capital costs to comply with regulatory requirements as a proportion of past capital expenditures indicates the proportion of the firm's available capital funds that might have to be diverted from other uses.

The U.S. EPA commissioned studies to determine which financial indicators and ratios best predict business failure. Three ratios were found by U.S. EPA contractors to have strong empirical correlation with business failure: **return**

**on assets, total debt to total assets and cash flow to total debt** (KPMG Peat Marwick Stevenson & Kellogg, Dec. 1990).

An additional 18 financial ratios and indicators were applied in the present analysis to achieve a more comprehensive assessment of the effects of potential MISA-related compliance costs. These financial indicators were obtained from prior MOE experience, US EPA experience and industry recommendations and represent measures of **profitability**, **solvency**, **liquidity** and **efficiency**. An annotated list of financial measures, ratios and indicators that are used in the present assessment is compiled and can be found in Appendix B.

### 6.3 Adjustment Procedure

Total MISA-related capital and operating costs for the Maximum Removal and the Most Cost Effective Removal levels of abatement plus actual or estimated MISA monitoring costs were added to (or subtracted from) appropriate items in the income statement and balance sheet for each firm for which data were available.

The "adjustment" procedure consists of the following steps and is explained in more detail in Appendix B:

1. "Before abatement", pro-forma average" income statements and balance sheets were calculated for each firm using consolidated financial data over the previous 10 years.

2. "Before abatement" financial indicators and ratios for the 10 year average and the most recent year for which full financial data were available were calculated.

3. Potential MISA costs were added to financial statements for the most recent year (1990), and the 10 year average.

4. "After abatement" financial indicators and ratios for the most recent year and the 10 year average were calculated.

The significance of the resulting ratios and indices may be evaluated two ways:

- the magnitudes of changes between the "before-abatement" and "after-abatement" results; and
- the "after abatement" indicators may be compared with threshold values defined below.

For purposes of the analyses, an assumption had to be made as to how the capital costs of the potential abatement technologies would be financed. For example, all added capital and operating costs may be deducted during a single year to show the absolute worst-case impact if expenses were financed entirely out of current revenues. A more accurate approach would be to assume debt financing of capital costs with operating costs deducted from current revenues.

For purposes of this assessment, it is assumed that the capital costs are financed by debt at 12% per annum over ten years. This is in keeping with evidence on the long-run pre-tax real rate of return in the Canadian manufacturing

sector (Tarasovsky, Roseman and Waslander 1980, Jenkins 1977, Pesando 1983)

As discussed in the Issues Resolution Process Committee Document (June 1990) and explained in a report by KPMG Peat Marwick Stevenson and Kellogg (Dec. 1990), there are no widely accepted and unequivocal thresholds by which one may determine whether a particular level of cost or whether specific magnitudes of changes in financial indicators is "economically achievable" for a firm or an industrial sector.

In this analysis, the "after abatement" financial indicators are compared with the following types of values to assess financial impact:

a) historical averages for the industry as a whole or for individual firms;

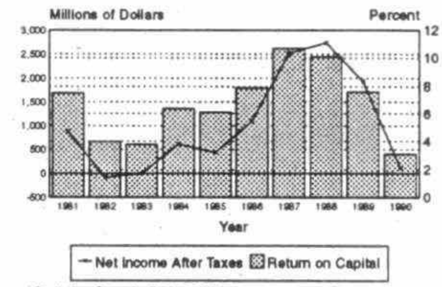
b) threshold values that are recommended and agreed upon by industry and/or financial analysts; or

c) ratios and indicators that were recorded (by a firm or the industry as a whole) during the "worst year" in terms of before-tax profit (ie. operating income) over the last ten years.

The economic performance of the Canadian pulp and paper industry over the ten-year period 1981-1990 is reviewed in the next two sections to provide a context for evaluation of financial impact assessment results.

Figure 6.1

Canadian Paper and Allied Group
Industry Performance 1981-1990




Source: Statistics Canada Cat 61-003

## 6.4 Financial Performance for the Canadian Industry 1981-1990

Financial ratios and indicators for each of the past ten years were calculated for the Paper and Allied Group using Statistics Canada data found in the report, Industrial Corporations (Cat. 61-003). Statistics Canada recognizes four categories of manufacturing under the general heading of Paper and Allied Industries: Pulp and Paper, Asphalt Roofing, Paper Boxes and Bags and Other Converted Paper products. Because the Pulp and Paper category is by far the largest segment of the four classifications in terms of output and data limitations, financial data for the Paper and Allied Group are used as an industry aggregate. The results of the assessment are listed in Appendix C.

As is evident in Figure 6.1, the ten year period, 1981-1990 encompasses a complete business cycle for the industry. The year 1981 was characterized by moderate returns for the industry which declined over the 1982-83 recession. Total net income (profit) fell from $873-million in 1981 to a loss of $90-million in

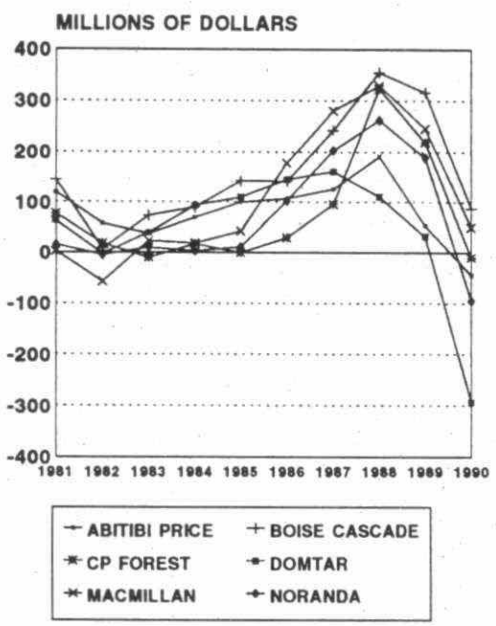
1982. Profits and return on capital began to rise again after 1984, peaked in 1987 and 1988 and fell again during 1989 and 1990 and continued to drop during 1991.

According to Price Waterhouse, the forest products industry recorded a net loss of $2.5 billion in 1991, the largest loss in the history of the forest industry in Canada. The wood pulp industry, a constituent of the forest products industry, recorded a loss of $575 million in 1991, a drop of $1.4 billion, compared to net earnings of $849 million in 1990.

Newsprint manufacturers lost $612 million in 1991, up from a 1990 loss of $307 million. Other papers and paperboard producers lost $109 million in 1991. This compared to a loss of $33 million in 1990 (Price Waterhouse, 1992).

**Figure 6.2**

**NET INCOME FOR SIX FIRMS WHICH OPERATE OPERATE PULP & PAPER MILLS IN ONTARIO**




As indicated in Figure 6.1 it is obvious that the pulp and paper industry and its constituent firms were in the downswing of their economic cycle through 1990 and losses for majority of firms continued through 1991 and 1992 as transaction prices for pulp and newsprint remained relatively low compared to prices in the late 1980s.

## 6.5 Historical Performance of Firms, 1981-1990

Complete financial data for each year between 1981-1990 are available in published form for six firms which own 14 of the 27 pulp and paper mills subject to MISA requirements. These firms include Abitibi-Price Ltd., Boise Cascade Corp., Domtar Inc., Canadian Pacific Forest Products, MacMillan Bloedel Ltd, and Noranda Forest Inc.

Noranda Forest Inc. purchased the Fraser mill in Thorold in 1985. In 1987, the two companies were amalgamated to form Noranda Forest Inc. The consolidated financial statements of Fraser Inc. from 1981 to 1985 were combined with those of Noranda Forest Products between 1986 and 1990 to create a complete financial statement that is associated with the Thorold mill.

Financial ratios for each of the past ten years were calculated for each firm in order to assess the past and current condition of the six companies. These ratios are printed in Appendix C. Figures 6.2, 6.3, 6.4 and 6.5 display the annual data for a number of selected financial performance indicators of profitability, liquidity and efficiency for each firm.

**Figure 6.3**

**RETURN ON ASSETS FOR SIX PULP AND PAPER FIRMS AND INDUSTRY AGGEGATE 1981-1990**

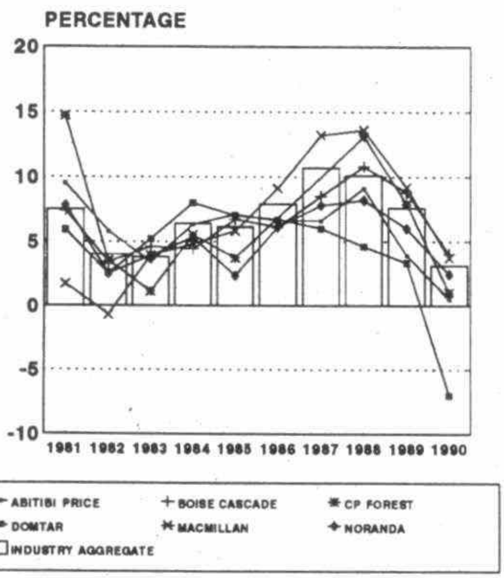



Figure 6.2 shows net income by firm for each year between 1981-1990. The graph indicates that, during the decade, the peak in the business cycle for most firms was greater than the trough. However, when 1991 results are added to the ten year period, it represents the worst year of financial performance in the decade for five of the six companies while 1990 was the worst year for the remaining firm.

Figure 6.3 displays return on assets for each year over the ten year period for the six firms and the aggregate industry. Analysts use this ratio to judge how efficiently a company is using its assets. During the latter half of the decade, three of the six firms managed to earn returns above the aggregate industry value. However in 1990, only two of the six firms earned returns on assets higher than the industry aggregate. One firm's return on assets fell substantially below zero.

Assuming that firms borrow to finance the costs of abatement, it is useful to review how firms have financed capital assets in the past. Commensurate with the aggregate industry, the relative debt levels for individual firms has been rising over the course of the decade as exhibited in Figure 6.4. Throughout the ten year period the debt to asset (D/A) ratio for three of the six firms was comparable with the industry ratio. Two firms exhibited D/A ratios above the industry in the latter part of the decade, particularly in 1990 and one firm consistently carried a D/A ratio above the aggregate industry.

An important criterion for firms taking on debt is their ability to acquire cash to repay the debt. Liquidity ratios are one indicator of this ability. Figure 6.5 displays the current ratio (defined as current assets/current liabilities) for each year between 1981 and 1990 for six firms and the aggregate industry. The ten year period started with a noticeable discrepancy between those firms with ratios near the industry average and those above it. By 1990 the gap between these groups had closed and the number of firms performing above the industry average dropped from three to two. As shown in Figure 6.4, current ratios for the industry and most firms have been falling each year subsequent to 1987 as a result of rising debt levels.

## 6.6 Financial Implications of MISA Related Costs

Total estimated capital and operating costs for the technologies associated

Figure 6.4

TOTAL DEBT TO TOTAL ASSETS
FOR SIX PULP AND PAPER FIRMS
AND INDUSTRY AGGREGATE 1981-1990

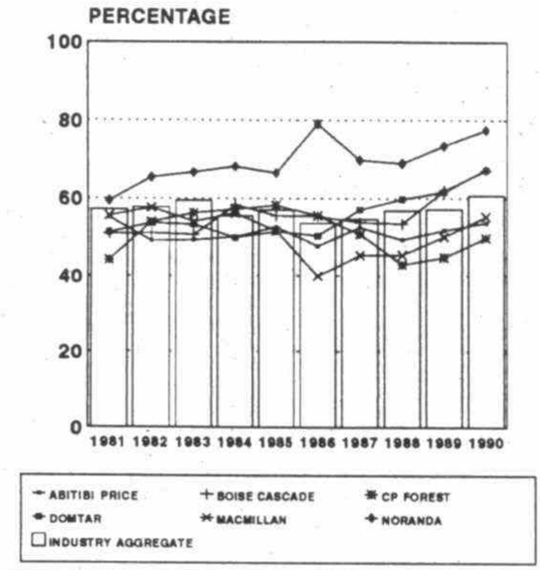
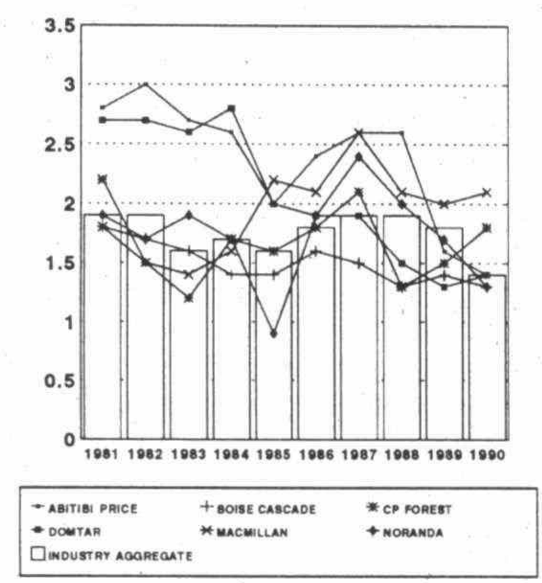



Figure 6.5

CURRENT RATIO
FOR SIX PULP AND PAPER FIRMS
AND INDUSTRY AGGREGATE 1981-1990




with the Maximum Removal BAT Option and the Most Cost Effective Removal Option were added to the costs of monitoring at each plant exhibited in Table 6.1 and used to proceed with the analysis.

Analyses presented in this section are based on the assumption that a company can borrow the capital required.

Furthermore, because no benchmarks or criteria were agreed upon by the subcommittee regarding threshold values and because plant-level financial data were not available, there is no objective basis for predicting plant closure or company bankruptcies. Judgmental conclusions about company responses to these costs and their effects are left to the reader.

Financial effects of the potential regulatory costs will be mitigated by the income tax system and by the Accelerated Capital Cost Allowance (ACCA). So long as the firm has profits against which to claim it, the ACCA can be applied to 25% of pollution control equipment costs in year 1, 50% in year 2 and 25% of these costs in year 3. Moreover, to the extent that taxable profits are reduced by MISA-related costs, the government shares in a reduction in tax revenues by about 40% of the profits reduced. The "after abatement" financial indicators and ratios that are calculated for each firm include the mitigating effects of the ACCA where applicable.

"After abatement" indicators and ratios for the most recent year (1990) and for the 1981-1990 average performance

values are shown for each company in Appendix C.

Financial impact results for each aggregate abatement option are discussed first on the ten year average financial data. The implications of recalculated financial indicators using 1990 financial data are discussed next.

Recall that the Maximum Removal Level (MAX) consists of applying technology trains K5+S2+F2+C2 while the Most Cost-Effective (MCE) option consists of the trains K2+S1+F1+C1 in each appropriate mill.

**Financial Consequences of the Most Cost Effective Option**

Effects of the MCE option on the six firms are presented in Tables C1-C6 in Appendix C and are illustrated in Figures 6.6, 6.8, 6.10, 6.12 and 6.14.

Ten Year Average

Changes in the financial performance indicators using ten-year average data ranged from 0% to 25%

For example, return on assets was reduced by about 0.2 % on average for the six firms. The percentage change in cash flow averaged 1 %.

In only a few circumstances did the costs associated with the MCE level push the financial indicators of a firm lower than the recorded performance achieved in the year that operating profit was at its lowest between 1981 and 1990. As illustrated in Figure 6.8, the debt to asset ratio of three firms (Abitibi-Price, Boise Cascade and CPFP) would climb to values higher than that exhibited by the firm during its worst year of operating profit performance.

As a percentage of annual capital expenditures, the annualized capital cost of the MCE level represents an average of 5% of 10-year annual average capital expenditures for the six firms for which data are available. However, estimated capital costs at the MCE level of control for Abitibi and Domtar would amount to 12.5% and 10% respectively, of those firms' recorded capital costs. (See Figure 6.10).

Table 6.2 lists the estimated changes in after-tax net earnings or profit for each firm as result of incurring costs associated with the MCE abatement level. The ten year average after-tax profit would decline by an average of 12%. One firm would incur a decrease in average after-tax profit of 25% (Domtar) while another (Noranda Inc.) would experience a decrease of only 2%.

This wide range of effect of potential abatement costs among firms makes it difficult to generalize about the financial effects of potential regulatory costs.

Most Recent Year

The most recent year, 1990, is also the worst year of operating profit performance for four of the six firms analyzed. Under the worst year of operating profit performance is also the most recent year, using the ratio and indicator values of the year in which the lowest after-tax profit was recorded, as thresholds to measure the effects of abatement is no longer valid. The

## Table 6.2

### Estimated Effects on After-Tax Profit of the Most Cost-Effective Option

| FIRMS | # OF PLANTS* | 1990 SALES | AFTER-TAX PROFIT ($millions) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 10 YEAR AVERAGE | | | 1990 | | |
| | | $millions | before abatement | after abatement | percent change | before abatement | after abatement | percent change |
| ABITIBI-PRICE INC | 4 | 3,088 | 82.0 | 62.8 | 23.4% | -44.6 | -89.2 | -100.1% |
| BOISE CASCADE CORPORATION | 2 | 4,884 | 160.4 | 151.4 | 5.6% | 87.8 | 78.9 | 10.2% |
| CANADIAN PACIFIC FOREST PRODUCTS | 2 | 2,133 | 75.6 | 65.8 | 13.0% | -9.4 | -31.6 | -236.1% |
| DOMTAR INC. | 4 | 2,134 | 46.2 | 34.8 | 24.8% | -294.0 | -328.3 | -11.7% |
| MACMILLAN BLOEDEL | 1 | 3,003 | 111.8 | 109.0 | 2.6% | 50.8 | 47.9 | 5.6% |
| NORANDA INC. | 1 | 4,555 | 70.1 | 68.4 | 2.3% | -95.0 | -98.8 | -4.0% |
| AVERAGE FOR 6 FIRMS | | 3,299.5 | 91.0 | 82.0 | 11.9% | -50.7 | -70.2 | |
| | | | | | | | Profitable | 7.9% |
| | | | | | | | Unprofitable | -87.9% |

* The number of plants displayed are the number of direct discharge pulp and paper mills in Ontario owned by the firm. It is not these plants alone that generated the 1990 sales or profits used in other columns.

imposition of abatement costs will naturally push current poor financial performance further below "worst year" values.

In this case, the magnitude of changes between "before-abatement" and after-abatement" results provide a useful evaluative tool to judge the significance of each abatement level scenario on data for the most recent year.

On average, returns on assets were reduced only 0.3 percentage points. Abitibi-Price experienced the largest reduction of 1.2 % in its return on assets. Cash flow dropped by an average of 12% for the six firms with Abitibi, again, incurring the largest decrease in its 1990 cash flow - a 46% decline.

The estimates in Table 6.2 indicate losses associated with regulatory costs for those firms already in a 1990 net-loss position up to 88% CPFP would incur the largest potential decrease, 236% or an increase in loss by $22.2 million. These large losses are the result of the fact that no ACCA can be claimed against expenses in years of a financial loss. A profitable firm would have available to it substantial mitigation of these effects by means of the ACCA. For example, when CPFP has a positive net income, as in the ten year average analysis, after-tax profit falls by about

## Table 6.3

### Estimated Effects on After-Tax Profit of the Maximum Removal Option

| FIRMS | # OF PLANTS* | 1990 SALES | AFTER-TAX PROFIT ($millions) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 10 YEAR AVERAGE | | | 1990 | | |
| | | $millions | before abatement | after abatement | percent change | before abatement | after abatement | percent change |
| | | | | | | | | |
| ABITIBI-PRICE INC | 4 | 3,088 | 82.0 | 59.1 | 27.9% | -44.6 | -97.5 | -118% |
| BOISE CASCADE CORPORATION | 2 | 4,884 | 160.4 | 143.5 | 10.5% | 87.8 | 70.9 | 19% |
| CANADIAN PACIFIC FOREST PRODUCTS | 2 | 2,133 | 75.6 | 50.0 | 33.8% | -9.4 | -79.1 | -741% |
| DOMTAR INC. | 4 | 2,134 | 46.2 | 36.1 | 22.0% | -294.0 | -325.8 | -10.8% |
| MACMILLAN BLOEDEL | 1 | 3,003 | 111.8 | 109.0 | 2.6% | 50.8 | 47.5 | 6.5% |
| NORANDA INC. | 1 | 4,555 | 70.1 | 68.4 | 2.3% | -95.0 | -98.8 | -4.0% |
| | | | | | | | | |
| AVERAGE FOR 6 FIRMS | | 3,299.5 | 91.0 | 77.7 | 16.5% | -50.7 | -80.5 | |
| | | | | | | | Profitable | 12.9% |
| | | | | | | | Unprofitable | -219% |

* The number of plants displayed are the number of direct discharge pulp and paper mills in Ontario owned by the firm. It is not these plants alone that generated the 1990 sales or profits used in other columns.

$10 million or 13%.

### Financial Consequences of the Maximum Removal Option

Consequences of the estimated costs associated with the Maximum Removal Level for the six firms are presented in Tables C7-C12 and illustrated in Figures 6.7, 6.9, 6.11, 6.13 and 6.15.

Ten Year Average and Most Recent Year

Effects of the Maximum Removal Option on financial indicators using both ten-year average data and 1990 data were similar to that of the Most Cost-Effective Option. This can be seen by comparing Figures 6.6 through 6.15. For example, return on assets for the six firms decreased by an average of 0.3 percentage points, an incremental increase of 0.1 percentage points beyond the MCE abatement level effects, while cash flow decreased by an average of 3%.

However, as displayed in Figure 6.13, the annualized capital cost of the Maximum Removal abatement level amounts to 28% of the ten-year historic average annual capital expenditures of Canadian Pacific Forest Products and 24% of Abitibi's 1990 capital expenditures.

The estimates in Table 6.3 indicate that the 2 firms with a positive net income or profit in 1990 would experience decrease of 6.5% and 19%. Firms experiencing a net loss in 1990 would see losses increase by an average of $39.6 million or 219%. As with costs associated with the MCE Level, the largest reduction in after-tax profit would be incurred by Canadian Pacific Forest Products, a decrease in net income of nearly $70 million dollars, a seven-fold increase of the firm's 1990 loss which skews the average upward.

### 6.7 Summary of MISA Related Cost Results

For three firms, profits (or losses) that were recorded in 1990 could fall (rise) by over $20-million when adjusted for the cost of the Most Cost-Effective Option. Because firms experienced net losses, they would have to bear the full capital cost of each abatement level scenario because profits are not available to be offset by Accelerated Capital Cost Allowance (ACCA). However, firms would be able to carry the unclaimed ACCA forward to offset any income earned in the future which is an asset to firms not accounted for in this analysis. Moreover, when 10 year average data are used to assess the same indicator, which is a positive value rather than a loss, the adverse effects imposed by the estimated regulatory costs are mitigated because ACCA can be claimed. The magnitude of these results are common to other firms in the sector.

One can conclude from these results that the financial effects of achieving the Maximum Removal degree of abatement are not significantly larger than those that could result from the Most Cost Effective level for the majority of firms and financial indicators. Moreover, financial effects are substantially mitigated when a firm has recorded positive profits due to the effects of ACCA.

For those firms in a loss position, the costs of achieving either the Most Cost Effective or the Maximum Removal degrees of abatement could cause an immediate reduction in cash flow but could have a small effect on profitability indicators.

If the economy recovers to pre-1990 levels, firms should be able to accommodate either the MCE or the MAX without severe disruptions. However, each firm could face capital constraints and shortages that might impede financing abatement programs in the short term.

Historic capital expenditures were compared to the annualized capital costs of abatement for an indication of possible capital diversion associated with each option. For the MAX Level, it was found that this ratio averaged 10.9% using 1990 data for the six firms and ranged from 0.3% to 28%. The same average for the MCE level was 6.5% with a range from 0.3% to 21%.

Assuming debt financing, three of the six firms could have their debt to asset ratios pushed to record levels if they incurred costs of the Maximum Removal level. This consequence can be problematic to companies that find their ability to borrow funds already strained by current economic conditions.

## 6.8 Effects of Costs of Complying with Environmental Regulations in Other Jurisdictions

Representatives of Abitibi-Price, Domtar Inc, MacMillan Bloedel and Noranda Forest Inc. submitted capital cost estimates that they would have to incur to comply with announced environmental regulations in jurisdictions outside of Ontario. These costs were added to the estimated MISA-related costs for Ontario mills in order to evaluate the potential financial consequences to firms of meeting environmental regulations in other Canadian jurisdictions in which they operate.

Because only capital cost estimates were provided, operating costs had to be estimated using the ratio of estimated Ontario operating costs to capital costs for each firm in order to assess the full potential effects on firm financial indicators. This calculation inherently assumes that technologies used in other provinces will be similar to that in Ontario.

While procedures outlined in the Issues Resolution Committee Reports explicitly excludes expenditures incurred in other jurisdictions, financial effects including these ex-Ontario expenses are presented here for comparative purposes. However, estimates for other jurisdictions are not verified by independent consultants nor are they necessarily of the same degree of reliability as the McCubbin estimates. Results of this analysis are presented in Appendix C.

Abitibi-Price

Even with the additional costs to meet regulations in other jurisdictions, none of the ten-year average financial indicators are pushed below the worst year thresholds by the added costs and net income remains positive for Abitibi-Price. However, it appears that the MCE level costs, combined with environmental expenditures in other jurisdictions, would have an impact on profitability, solvency and liquidity if early 1990s financial performance were to continue. The effects of the Maximum Removal degree of abatement are slightly worse than exhibited with Ontario costs alone.

Annualized capital costs for other jurisdictions plus MCE cost levels in Ontario represent 48.6% of 1990 capital expenditures and 51.6% for the MAX level. Thus, about half of Abitibi's historical capital expenditure would be diverted to environmental protection under these assumptions.

Domtar

None of the ten-year average financial indicators are pushed below the worst year thresholds. However, with the adjustment for added abatement costs in other jurisdictions, the 10-year average net income becomes negative (a net loss).

This result implies that even if Domtar's performance returns to a level mirroring its average performance over the last 10 years, the spending required to meet potential pollution requirements in Quebec and Ontario could force the firm into a loss position.

MacMillan Bloedel

Only two of the ten-year average financial indicators are pushed below the worst year thresholds. Total Debt to Assets would climb to 58.6% indicating a solvency problem for the firm as the debt load is increased to finance the environmental protection investments. The ten-year average net income has been positive and would remain positive after adjustments for estimated environmental protection investments. However, total annualized capital costs represent 215% of MacMillan's 1990 capital expenditures.

Noranda

None of the ten-year average financial indicators are pushed below the worst year thresholds. While net income (profit) could fall by 22%, the total annualized capital cost of environmental expenditures only represents 3% of 1990 capital expenditures.

Because the regulatory costs were added to potential Ontario costs, changes in financial indicators were greater for each firm that would be subject to added expenses in other jurisdictions compared with the financial effects of expenses incurred only in Ontario. Where debt loads and diversion of capital were identified at some firms as reaching high levels with Ontario costs alone, the addition of costs to meet environmental regulations in other jurisdictions exacerbate these results.

## 6.8 Final Perspective

Environmental protection programs are concerned with short-to-medium time horizons (3-5 years) required to implement new programs and with the longer-term (10-20 years) during which program benefits are often realized.

For this reason, effects on both long-term performance (ten-year average) and short term performance (most recent year) were analyzed.

In the short term, both options exacerbate poor financial results with the MAX option having a larger effect on the financial position of the firms analyzed than the MCE option.

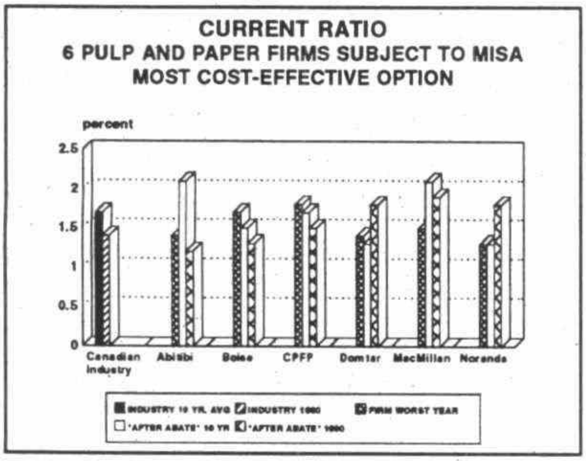
Assuming debt financing, three of the six firms could have their debt to asset ratios pushed to record levels if they incurred costs of the Maximum Removal level. This consequence can be problematic to companies that find their ability to borrow funds already strained by current economic conditions.

The results of the analysis indicate that the MCE option would do less to exacerbate current poor financial results among the firms analyzed than would the MAX scenario.

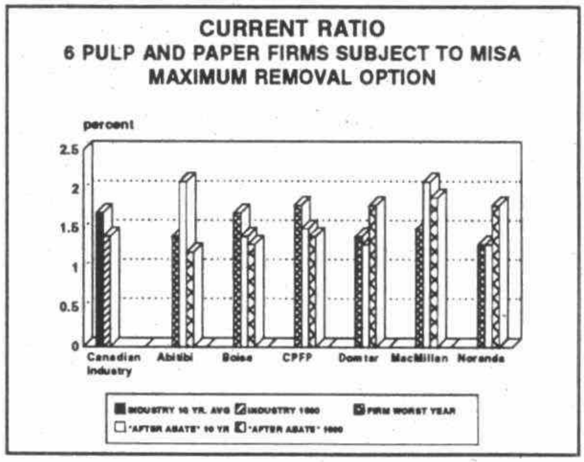
In the longer term, the impacts on average long-term performance were small for both the MAX and MCE options. If economic performance of the next 10 years are equal to or better than the past decade on average (including the 1990-92 recession), firms in Ontario should be able to implement the MCE or the MAX level of abatement without violating threshold values suggested for this analysis.

The next Chapter looks at the potential effects of MISA-related costs on the competitiveness of Ontario mills.

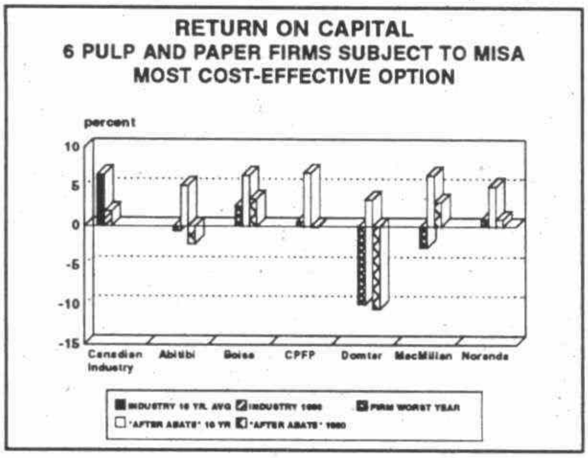
## Figure 6.6



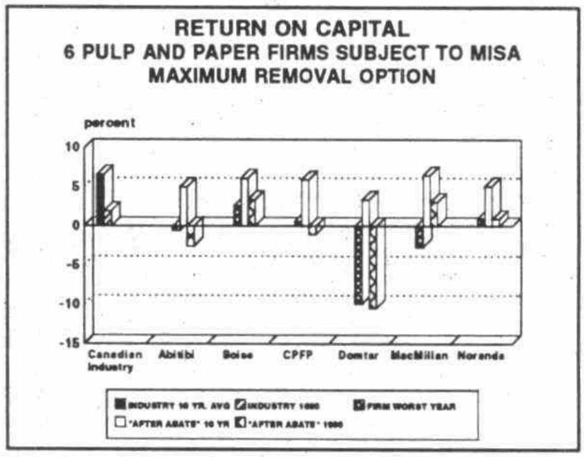

## Figure 6.7



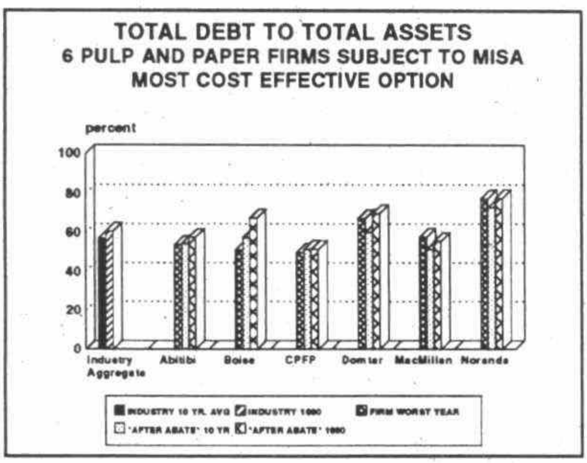

## Figure 6.8



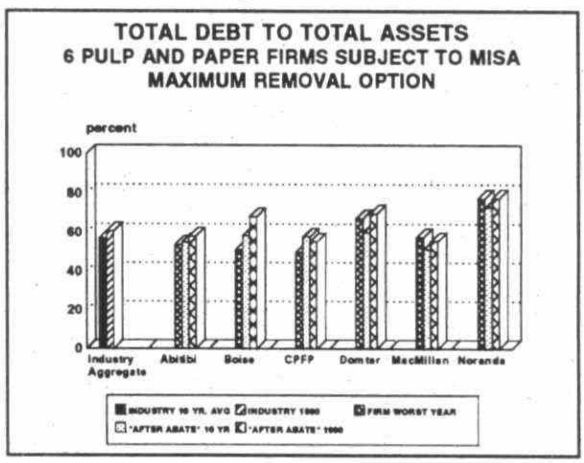

## Figure 6.9



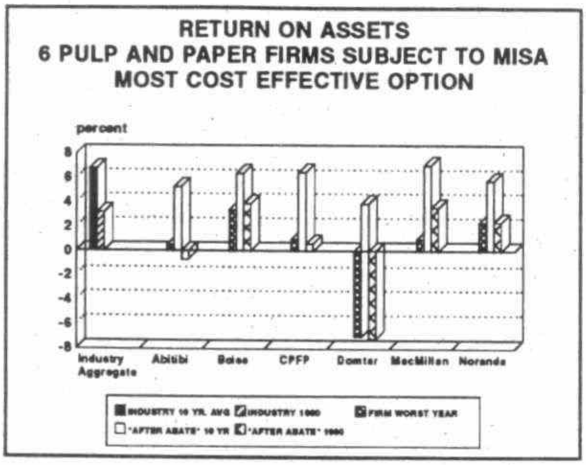

## Figure 6.10



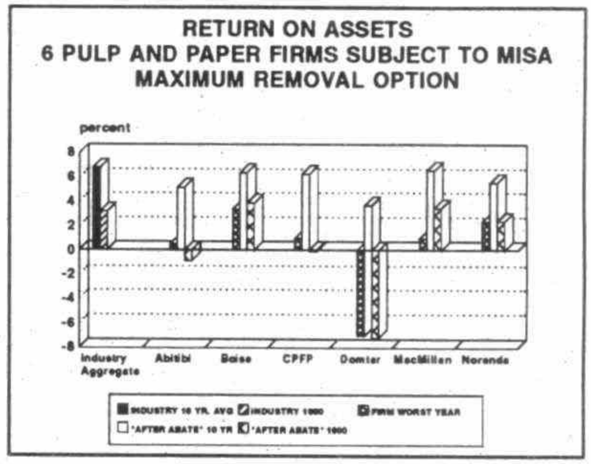

## Figure 6.11



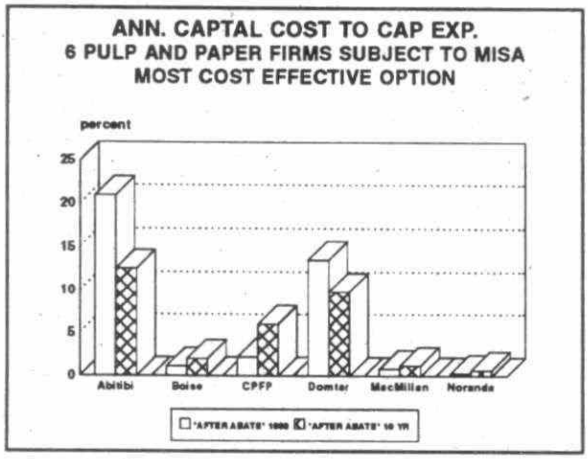
## Figure 6.12



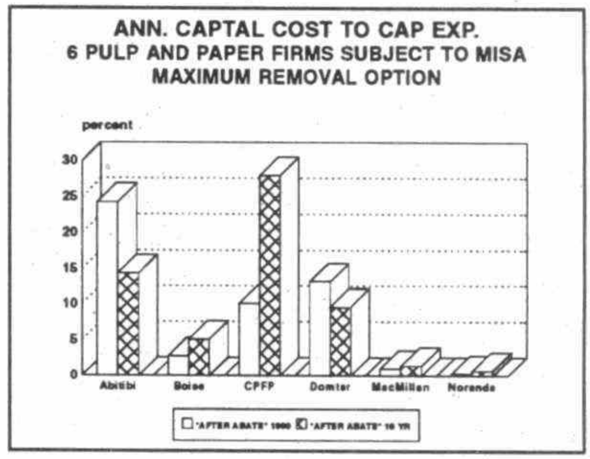

## Figure 6.13




## Figure 6.14




## Figure 6.15



# 7.0 IMPLICATIONS FOR COMPETITIVENESS

*The production cost structure of Ontario firms relative to competing firms in other jurisdictions is the key measure of competitiveness examined in this report. Although environmental protection costs are just one of many factors that affect competitiveness, potential MISA-related regulatory costs could influence the competitive circumstances facing Ontario pulp and paper mills.*

*Costs associated with the Most Cost-Effective Control Option and the MISA monitoring requirements would not displace Eastern Canadian pulp mills from their current position as the third lowest cost producer among the regions compared. However, if the Maximum Removal Option costs were incurred, Eastern Canadian market pulp producers would be pushed from their third lowest cost position to the highest cost producer among the producing regions examined.*

*For newsprint producers, neither aggregate abatement configuration raises total operating costs sufficiently to displace Canadian mills from their position as the second highest cost producers. However, the additional costs could widen the gap that currently exists between Canadian producers and their main competitors, American producers.*

*The competitive position of Ontario pulp and paper mills seems also to rest to a large degree on the U.S./Canadian dollar exchange rates, over which individual firms or even the industry as a whole have very little control. The analysis indicate that assuming a \$0.87 U.S. dollar, it would require a depreciation of the Canadian dollar of 4% in order for the industry to accumulate funds equal to the proposed annualized MISA costs under the Most Cost Effective Option. An exchange rate depreciation of 7% would be necessary to generate extra revenue equal to the annualized cost of the Maximum Removal Option. Between November 1991 and July 1992, the period of completing this report, the Canadian dollar has in fact depreciated far more than 4% to below \$0.80 U.S.*

## 7.1 Cost Competitiveness

In his recent study of Canadian competitiveness, Michael Porter aimed criticism at Canadian business, government and labour for Canada's poor competitive performance in recent years. He warned that productivity must improve if Canadians are to raise or even maintain present incomes and standards of living. The federal government echoed this message in its own competitiveness proposals calling on Canadian business and labour to increase investment, particularly in research and development and in education (Prosperity Secretariat, 1992).

The main reason that competitiveness has garnered a high profile recently is the deterioration of Canada's competitive position relative to the U.S. since 1985. Evidence of the competitive pressure on Ontario includes the increase in cross-border shopping and the many lay-offs and closures in manufacturing plants across the province. Pressures on Ontario's manufacturing sector were not only the result of a relatively high Canadian dollar, weak North American demand and an increase in global competition, but also stemmed from the reduction of tariffs under the Canada-U.S. Free Trade Agreement of January, 1989.

The most important competitors to Ontario paper firms and mills are located in the Southern and Western States of the U.S., Sweden, and Finland as well as the Canadian provinces of British Columbia and Quebec. Market pulp and, to a lesser degree, newsprint from producers in Central and South America are finding their way to U.S. markets but these sources of fibre are currently viewed as potential rather than actual competitors. Scandinavian fine paper and specialty grades are seen as significant competition in North American markets for these products.

Regulation and Competitiveness

The measurement of competitiveness is an illusive task. According to **The World Competitiveness Report**, prepared by the Institute Etude Methods Direction Enterprises (IMEDE) and the World Economic Forum, "Competitiveness is the ability of entrepreneurs to design, produce and market goods and services, the price and non-price qualities of which form a more attractive package than that of competitors" (Garelli, July 1989). **The World Competitiveness Report** annually ranks the competitiveness of 22 countries using 292 criteria which are grouped into ten categories. While these criteria include environmental protection regulation as a factor that affects competitiveness, it was not singled out as being particularly important.

In a study of Canada's competitiveness for the Conference Board of Canada, Johnston (February, 1990) cites the following key factors as important to increasing competitiveness: R&D spending, productivity, human resources development, customer satisfaction, flexible organizational structures, critical self analysis, creativity, and enhanced intelligence gathering capabilities. Again, environmental regulatory activity in a jurisdiction is not identified as a key issue for competitiveness.

**Table 7.1**

**Ranking of Market Pulp Producing Regions**
**Delivered Cost per Finished Tonne**
**1985 and 1989**
**Current Canadian Dollars**

| Region | 1989 | 1985 | Cumulative % Change |
|---|---|---|---|
| | | | |
| U.S. South | $435 | $494 | -12 |
| U.S. West | 553 | 518 | 7 |
| **Eastern Canada** | **568** | **511** | **11** |
| B.C. Coast | 593 | 528 | 12 |
| Sweden | 593 | 451 | 32 |
| Finland | 605 | 476 | 27 |
| B.C. Interior | 607 | 477 | 27 |

Source: FSAC, Market Pulp Industry Cost Study, 1985-1989, October 1990

## Table 7.2

**Cost Components**
**During 1989 for Market Pulp Mills**
**In Seven Regions**

| | U.S.South | U.S.West | **Eastern Canada** | B.C. Coast | B.C. Interior | Finland | Sweden |
|---|---|---|---|---|---|---|---|
| Wood Fibre | 132 | 219 | **252** | 217 | 192 | 388 | 353 |
| Chemicals | 75 | 57 | **62** | 53 | 66 | 60 | 41 |
| Energy | 24 | 39 | **24** | 35 | 32 | 4 | 10 |
| Labour | 68 | 67 | **79** | 114 | 96 | 49 | 81 |
| Other | 62 | 75 | **65** | 88 | 115 | 41 | 43 |
| Total mill Level | 361 | 457 | **482** | 507 | 501 | 542 | 528 |
| Corporate and selling | 14 | 16 | **24** | 23 | 9 | 13 | 12 |
| Delivery | 60 | 80 | **62** | 63 | 97 | 50 | 53 |
| Total Delivered | 435 | 553 | **568** | 593 | 607 | 605 | 593 |

Forest Sector Advisory Council, October 1990a.

### Competitiveness Among Pulp and Paper Producers

The Forest Sector Advisory Council (FSAC) (October 1990a; October 1990b) compared production costs (in Canadian dollars, CAD$) per air dried tonne (ADT) of output among competing mills that produce newsprint and market pulp in different jurisdictions.
Market Pulp

Table 7.1 shows the ranking among market pulp producers in 1989 and compares costs in 1989 with those incurred during 1985. In 1989, market pulp producers in the U.S. South recorded the lowest delivered cost of newsprint, CAD$ 435 per finished ADT, while B.C Interior producers had the highest cost at CAD$ 607/ADT.

According to the FSAC study, between 1985 and 1989, the competitive position of pulp mills in Eastern Canada improved from fifth to third place while Swedish and Finnish mills fell from first and second place, respectively to fifth and sixth place respectively. Mills in the B.C. Coastal region improved from seventh place to fourth in terms of their production costs while the B.C. Interior mills fell from being the third lowest cost producer in 1985 to the seventh in 1989. Producers in the U.S. South and U.S. West made significant gains in their competitive positions moving from the fourth and sixth positions, respectively in 1985 to the top two spots in 1989. In Canada, Eastern Canadian mills appear to be the lowest cost producers.

## Table 7.3

**Comparison of Labour Productivity and Mill Age of Market Pulp Producing Regions - 1989**

| Region | Labour(1) Productivity | Mill Age(2) |
|---|---|---|
| Finland | 1.7 | 1981 |
| U.S. West | 1.9 | 1982 |
| U.S. South | 1.9 | 1976 |
| Sweden | 2.2 | 1980 |
| B.C. Interior | 2.3 | 1975 |
| Eastern Canada | 2.4 | 1973 |
| B.C. Coast | 3.1 | 1976 |

(1) operating labour hours worked per ADT of market pulp
(2) weighted average age of pulping facilities based on the date of the last major rebuild of the major components
Source: FSAC, Market Pulp Industry Cost Study, 1985-1989, October 1990

## Table 7.4

**Capital Expenditures in the Market Pulp Industry**

| | Capital Investment | |
|---|---|---|
| Region | Cumulative expenditures 1985-1989 \$C/ADMT | Planned for 1990 |
| B.C. Coast | \$541 | \$538 |
| Finland | 502 | 105 |
| U.S. West | 305 | 105 |
| B.C. Interior | 395 | 103 |
| U.S. South | 217 | 47 |
| Sweden | 186 | 50 |
| Eastern Canada | 72 | 45 |

Forest Sector Advisory Council, October 1990a.

Table 7.2 shows disaggregations of 1989 costs into average mill level costs for the purpose of comparison across regions. The estimates shown in Table 7.2 indicate that mills in Canada, particularly those in British Columbia, have higher labour and delivery costs relative to U.S. and Scandinavian mills, while mills in Canada enjoy lower energy and average fibre costs.

A closer look at labour costs indicates that Canadian mills experience the lowest productivity when compared to competing regions. Mills in B.C. exhibit the highest number of operating labour hours worked per ADT of market pulp.

The correlation between mill age, and productivity is evident in Table 7.3. Finland and the U.S. West which exhibit the highest labour productivity also possess the newest mills.

Based on the estimates shown in Table 7.4, Canadian mills appear to have invested less capital than other high wage producers and so have achieved less substitution of capital for labour in basic operations. Over the 1985 to 1989 period, capital investment in Eastern Canada on a per tonne basis has been lower than in any other regions.

### Newsprint

As indicated in Table 7.5, newsprint producers in the U.S. South achieved the lowest delivered cost of newsprint at CAD\$ 485/ADT and Finnish producers had the highest cost at CAD\$ 625/ADT during 1989. However, the FSAC newsprint study did not disaggregate Eastern Canadian mills from those in the rest of the country, although Ontario mills

**Table 7.5**

**Ranking of Newsprint Producing Regions**
**Delivered Cost per Finished Tonne**
**1985 and 1989**
**Current Canadian Dollars**

| Region | 1989 | 1985 | Cumulative % Change |
|---|---|---|---|
| | | | |
| U.S. South | $485 | $526 | -8 |
| U.S. West | 509 | 519 | -2 |
| Sweden | 570 | 460 | 20 |
| Canada | 573 | 530 | 8 |
| Finland | 625 | 490 | 28 |

Source: FSAC Newsprint Cost Study, 1990

produce about 21% of Canada's total output of newsprint.

Between 1985 and 1989, the competitive position of Canadian mills in terms of costs has improved from fifth to fourth place. In addition, rankings of the two U.S. regions improved relative to the Nordic countries.

As shown in Table 7.6, the cost of furnish material is the largest newsprint mill cost component in all regions and, during 1989, ranged from 34% of total mill level costs for the U.S. South to 56% for Finland. Canada represents the second lowest furnish material cost in the market, an important competitive advantage.

A comparison of paper machine capacity and mill operating hours worked per finished tonne of newsprint in the different jurisdictions (see Table 7.7) reveals the correlation between machine size and labour productivity. Finland and Sweden which have the largest capacity paper machines also have the second highest labour productivity at 2.1 hours worked per finished tonne of newsprint. Operating labour hours per finished tonne in 1989 were lowest for U.S. West producers at 1.8 because of the more wide spread use of recycled fibre and chips instead of roundwood. By comparison, Canadian mills require 3.8 operating hours per finished tonne of newsprint reflecting the high use of labour intensive stone groundwood mills and small newsprint machines (FSAC, 1990b).

Based on the FSAC studies, Canadian mills are, on average, the second most expensive producers of newsprint, as indicated in Table 7.4, while Eastern Canadian mills are the third lowest cost producer of wood pulp as shown in Table 7.1.

## 7.2 Importance of the Exchange Rate to the Ontario Pulp and Paper Industry

Along with labour productivity, changes in competitive positions of different regional aggregations for both market pulp and newsprint producers can be attributed to a large degree to fluctuations in exchange rates. Table 7.6 lists currency exchange rates for the U.S., Canada, Sweden and Finland between 1985 and 1990. Over the 1985 to 1989 period, the value of the Swedish and Finnish currencies has increased by 15.7% and 24.9% respectively, relative to the Canadian dollar. This means that importers of Swedish goods pay about 16% more in Canadian funds to receive the same amount of paper products.

## Table 7.6

**Cost Components**
**During 1989 for Newsprint Mills**
**in Five Regions**
**Current Canadian Dollars/ADMT**

| | U.S. South | U.S. West | Sweden | Canada | Finland |
|---|---|---|---|---|---|
| Furnish Material | 143 | 203 | 214 | 172 | 285 |
| Energy | 95 | 85 | 99 | 83 | 97 |
| Labour | 86 | 72 | 76 | 122 | 60 |
| Other Mill Level | 104 | 85 | 92 | 81 | 66 |
| Total mill Level | 428 | 445 | 481 | 458 | 508 |
| Corporate & selling | 20 | 14 | 11 | 32 | 34 |
| Delivery | 37 | 50 | 78 | 83 | 83 |
| Total delivered Cost | **485** | **509** | **570** | **573** | **625** |

Forest Sector Advisory Council, October 1990b.

Currency exchange rates affect the profitability of firms when they sell their product in foreign markets priced in foreign currencies. Therefore, if firms from all regions sell to the U.S. market, the relative value of the U.S. dollar will affect their profitability.

The large increase in currency values has adversely affected the competitiveness of Finnish and Swedish producers as can be seen in Tables 7.1 and 7.5.

The fall in the value of the Canadian dollar relative to U.S. currency between 1985 and 1986 enhanced the competitive position of Canadian producers. This advantage eroded during 1987, 1988 and 1989 when the Canadian dollar increased by about 15% relative to the U.S. dollar. The earlier relatively high value of the Canadian dollar adversely affected Canadian firms' earnings position and added to the problems created by falling product prices.

The recent depreciation of the Canadian dollar against the U.S. dollar should help firms' earnings and cash flow rebound from previous record losses.

Schembri and Robisheau (Sept. 1986) have examined the impact of Canadian-U.S. exchange rates on output, employment and profits of the Canadian pulp and paper industry over the 1962-1983 period. They found that the effect of currency depreciation was considerably greater on profits than on the other two dependent variables. A one per-cent depreciation of the Canadian currency relative to the U.S. was reported to generate more than a 2 per cent increase in profit together with increases of 0.6% and 1.2% in output and employment respectively (Schembri and Robisheau, Sept. 1986). Evidence

## Table 7.7

**Comparison of Labour Productivity and Machine Capacity of Newsprint Producing Regions - 1989**

| Region | Labour Productivity (1) | Machine Capacity (2) |
|---|---|---|
| U.S. West | 1.8 | 132 |
| Finland | 2.1 | 178 |
| Sweden | 2.1 | 175 |
| U.S. South | 2.6 | 146 |
| Canada | 3.8 | 104 |

(1) operating labour hours worked per Finished tonne of newsprint
(2) Average annual capacity per Newsprint machine (000s) of tonnes

Source: FSAC, Newsprint Cost Study, 1985-1989, October 1990

from the Forest Sector Advisory Committee supports this finding.

Consequently, the competitive position of Ontario pulp and paper mills seems to rest to a large degree on the U.S./Canadian dollar exchange rates, over which individual firms or even the industry as a whole have very little control. To put potential MISA costs into perspective and illustrate the degree of uncertainty associated with assessments of financial impacts, the value of Ontario shipments to the United States in 1989 is estimated at $2.2 billion (See endnotes). At an exchange rate of $1 Canadian = $0.87 U.S., and assuming shipments remain constant, a 1% depreciation in the U.S.-Canadian exchange rate would net the Ontario industry approximately $22,000,000 in additional revenue (see endnotes for calculations).

Following this logic, it would require a depreciation of the Canadian dollar of 4% in order for the industry to accumulate funds equal to the proposed annualized MISA costs under the Most Cost Effective Option. An exchange rate depreciation of 7% would be necessary to generate extra revenue equal to the annualized cost of the Maximum Removal Option (see endnotes for calculations).
Between November 1991 and July 1992, the period of completing this report, the Canadian dollar has in fact depreciated to $0.835 U.S. from $0.87 U.S.

### 7.3 MISA Costs Per Unit of Product Produced

Ontario produced a total of 8.3 million tonnes of wood pulp and basic paper and board in 1990 of which 2.35 million tonnes were kraft pulp and 2 million tonnes were newsprint (Table 3.1). To determine the effects of MISA-related regulatory costs on the competitive position of Ontario's pulp and paper industry, the annualized cost of each BAT option was divided by the Ontario pulp and paper production statistic to get a regulatory cost/tonne of production. Adoption of the Maximum Removal option would cost sulphate (kraft) pulp mills an average of $50 per tonne of pulp produced ($177 million / 2.35 million tonnes), while the adoption of the Most Cost Effective Removal Option would cost the category mills about $20 per tonne of pulp ($46.3 million / 2.35 million tonnes).

Adoption of the Maximum Removal Option by newsprint mills would cost the sulphite-mechanical pulp category about $22 per tonne of newsprint produced ($43.8 million / 2.0 million tonnes), while the Most Cost Effective Removal Option

**Table 7.8**

**Exchange Rates to Canadian Dollars For Major Pulp and Paper Producing Regions 1985-1990**

| Year | Canada | U.S.A. | Finland | Sweden |
|---|---|---|---|---|
| | $ | $ | Markka | Krona |
| 1985 | 1.00 | 1.366 | 0.221 | 0.159 |
| 1986 | 1.00 | 1.389 | 0.274 | 0.195 |
| 1987 | 1.00 | 1.326 | 0.302 | 0.209 |
| 1988 | 1.00 | 1.231 | 0.294 | 0.201 |
| 1989 | 1.00 | 1.184 | 0.276 | 0.184 |
| 1990 | 1.00 | 1.170 | 0.298 | 0.193 |

Exchange rates are based on daily averages of spot rates quoted on national markets.

Source: FSAC Newsprint Cost Study, 1990

would cost the category $18/tonne of newsprint produced.

Adding these unit regulatory costs to the relevant average delivered cost shown in Tables 7.1 and 7.5 indicates whether ordering of different regions in terms of total production costs would be changed.

The cost of the Most Cost Effective Control Option would increase total delivered cost in Eastern Canadian Mills from $568 per ADT to $588 per ADT but would not displace Eastern Canadian mills from their current position as the third lowest cost producer. However, the extra regulatory costs would widen the difference between Eastern Canadian and U. S. market pulp producers. If the Maximum Removal Option costs were incurred, total delivered cost would increase to $618 per ADT for Eastern Canadian producers. At this cost, Eastern Canadian mills would be displaced from their third lowest cost position to the highest cost producer among the regions examined.

For newsprint producers, the Most Cost Effective Option would increase total delivered cost from $573 per finished tonne to $591 per finished tonne while the Maximum Removal Option would push the cost up to $595 per finished tonne. While neither BAT option raises costs sufficiently to displace Canadian mills from their position as the second highest cost producers, the addition of regulatory costs increases the gap that currently exists between Canadian producers and their main competitors, American producers.

## 7.4 MISA Costs as a Proportion of Manufacturing Costs

Direct manufacturing costs are divided into four components: wood fibre cost (roundwood and wood residue), the cost of other purchased materials and supplies (chemicals, etc.), energy costs (purchased fuel and electricity), and labour costs (salaries and wages). From 1970 to 1985, the latest year for which data are available, direct costs amounted to between 67% (1974) and 83% (1976 and 1982) of the value of Ontario shipments. The average for the period was approximately 78%.

Table 7.9 presents details of the relative shares of direct costs, by major cost component, between 1970 and 1985. Over this period, the cost of wood fibre fell from approximately 30% of total direct costs in 1970, to roughly 25% in 1985.

## Table 7.9
## Direct Manufacturing Cost Components in the Ontario Pulp and Paper Industry 1970-1985

| Year | Cost of Residue and Roundwood $000s | Cost of Materials and Supplies $000s | % of Total | Cost of fuel and Electricity $000s | % of Total | Cost of Salary and Wages $000s | % of Total | Total Direct Cost Excluding Wood Cost $000s | Value of Shipments $000s | Total Direct Cost to Value of shipments |
|---|---|---|---|---|---|---|---|---|---|---|
| 1970 | 172,525 | 169,470 | 41.2 | 53,295 | 13.0 | 188,189 | 45.8 | 410,954 | 732,424 | 56.1 |
| 1971 | 171,462 | 168,367 | 40.4 | 58,158 | 14.0 | 190,348 | 45.7 | 416,873 | 789,289 | 52.8 |
| 1972 | 179,756 | 179,068 | 40.0 | 61,944 | 13.8 | 206,929 | 46.2 | 447,941 | 778,167 | 57.6 |
| 1973 | 189,410 | 217,506 | 42.5 | 67,593 | 13.2 | 227,160 | 44.3 | 512,259 | 932,061 | 55.0 |
| 1974 | 236,372 | 319,991 | 47.8 | 84,395 | 12.6 | 265,286 | 39.6 | 669,672 | 1,347,587 | 49.7 |
| 1975 | 207,073 | 232,976 | 42.4 | 82,775 | 15.1 | 233,645 | 42.5 | 549,396 | 1,031,210 | 53.3 |
| 1976 | 268,833 | 310,565 | 41.0 | 131,311 | 17.3 | 315,867 | 41.7 | 757,743 | 1,236,886 | 61.3 |
| 1977 | 341,822 | 399,021 | 46.2 | 181,396 | 21.0 | 283,016 | 32.8 | 863,433 | 1,603,037 | 53.9 |
| 1978 | 382,981 | 446,895 | 41.5 | 210,538 | 19.6 | 419,289 | 38.9 | 1,076,722 | 1,780,225 | 60.5 |
| 1979 | 435,226 | 594,728 | 68.1 | 231,900 | 26.6 | 461,812 | 52.9 | 1,288,440 | 2,233,098 | 57.7 |
| 1980 | 482,217 | 677,564 | 47.0 | 254,886 | 17.7 | 510,279 | 35.4 | 1,442,729 | 2,614,443 | 55.2 |
| 1981 | 545,137 | 745,780 | 46.3 | 294,149 | 18.3 | 570,463 | 35.4 | 1,610,392 | 2,847,780 | 56.6 |
| 1982 | 503,419 | 718,717 | 43.7 | 317,107 | 19.3 | 610,703 | 37.1 | 1,646,527 | 2,593,734 | 63.5 |
| 1983 | 571,779 | 750,238 | 43.0 | 349,823 | 20.1 | 644,317 | 36.9 | 1,744,378 | 2,819,209 | 61.8 |
| 1984 | 646,914 | 867,796 | 45.4 | 372,224 | 19.5 | 672,579 | 35.2 | 1,912,599 | 3,362,436 | 56.9 |
| 1985 | 654,775 | 898,240 | 45.7 | 365,282 | 18.6 | 701,649 | 35.7 | 1,965,171 | 3,441,868 | 57.1 |

Source: Great Lakes Forestry Centre, The Ontario Pulp and Paper Industry, 1987

In addition, the cost of salaries and wages fell from a high of 33% of total direct costs in 1972 to 26% in 1984. On the other hand, the cost of energy increased from 9% in 1970 to just over 15% in 1983. The cost of materials and supplies, excluding wood fibre, varied considerably over the years, increasing from 29% in the 1970-72 period to 41% in 1977 and levelling out at about 33% after that.

Proposed MISA costs would impact all components of direct manufacturing cost except wood fibre costs. Excluding wood fibre cost, the total direct manufacturing cost for Ontario mills in 1985 was $1.97 billion. Assuming that direct costs have not changed over time, the operating cost for the Most Cost Effective Option amounts to a 2% increase in direct costs. The total annualized cost, which combines the annualized capital and annual operating costs, amounts to 5% of direct manufacturing costs.

For the Maximum Removal Option, the shares are 3% and 9%, respectively, for operating costs and annualized costs. These shares overstate the impact on costs to the industry because the direct costs used in the analysis are 1985 costs, in 1985 dollars, which would be somewhat lower than costs incurred during 1990.

## 7.5 Other Issues Affecting Competitiveness

There are a number of competing issues to be addressed by Ontario and Canadian pulp and paper companies whose implications for competitiveness will be difficult to disentangle from the effects of potential environmental requirements. These issues contribute to the uncertainty associated with the cost competitiveness and the changes in financial performance that regulatory costs might induce.

### Timber Supply

Sustainable supplies of desirable species of timber is one of the most far reaching and contentious issues facing the pulp and paper industry. While hardwoods such as poplar and aspen are abundant, high quality softwood stands are becoming increasingly remote and the costs of harvesting this fibre are growing. Furthermore, competition for the use or conservation of harvestable areas has emerged from native and environmental groups. Moreover, pulp and paper companies are being challenged to take more responsibility for regenerating and reforesting cut-over timber lands. In Ontario, regeneration has long been carried out by the provincial government which receives some revenues to cover these and other forest management costs from timber rights payments. Timber and pulp and paper companies are facing the prospect of paying more for wood limits to defray forest management costs or undertaking forest planting and regeneration themselves on the lands that they lease from the crown.

These issues have been debated in the public hearings for the Class Environmental Assessment of the Ontario Ministry of Natural Resources Timber Management Plans.

Forestry firms are also contemplating harvesting of "second-growth timber", timber grown in previously harvested

areas. However, because second-growth species lack the strength and yield capabilities of old-growth, the pulp and paper industry must derive new methods of production and processing if they are maintain the quality of their products. Wood harvesting costs are, therefore, likely to increase during the next decade while fibre quality may, in fact, decline.

### Secondary Fibre Content Requirements

Public pressures combined with growing scarcity of landfill capacity in many U.S. cities has led to State and local legislation that require U.S. newspaper publishers to use up to 50% secondary fibre content in their newsprint. Newsprint mills can add Old newspapers to their pulp furnish up to 10% without deinking. Only two Ontario newsprint producers, Quebec and Ontario and Atlantic Packaging, have installed secondary newsprint deinking equipment and have the capability of producing newsprint with up to 100% secondary fibre content. The CPFP mill in Thunder Bay commenced operating a newsprint deinking facility in September 1991.

Ontario mills have installed about 440,000 tonnes per year of secondary newsprint deinking and processing capacity. Firms have announced the construction of another 220,000 tonnes per year. Firms in the U.S. have installed capacity to produce over 2 million tonnes of recycled newsprint and are currently harvesting their "urban forests" of post consumer old newspaper.

Since most Ontario newsprint mills are located in the North near their wood supplies, these firms face serious challenges in producing newsprint with secondary fibre content. First, demand and prices of post consumer newspapers for deinking are growing but supplies, being generated in Southern Ontario urban communities, are below projected requirements. There is also much uncertainty as the potential quantities of usable waste newsprint that are recoverable from Canadian cities. Firms are reluctant to commit to investments in secondary fibre deinking facilities when they are unsure of whether sufficient supply of raw material will be available to operate these mills. Second, transportation costs of waste news to northern mills for processing may be too high to permit the use of this raw material in some northern locations.

### Canada/U.S. Free Trade Agreement

The Free Trade Agreement between Canada and the United States has made little difference for market pulp and newsprint markets which have always been free of tariff barriers between the two countries. However, tariff reductions for all other paper and paperboard products have been accelerated. In January of 1991, tariffs on these products were cut by 30%. A further 50% reduction was made in 1992 and duties will be completely eliminated in 1993.

As noted, removal of these tariffs will result in increased competition in domestic markets but opens opportunities for Canadian paper and board producers to produce larger quantities of product for export and capture economies of scale. Investments to expand production facilities may be accompanied by modernization and

process changes that reduce pollution discharges at the same time.

### 7.6 Environmental Protection Activities in Other Jurisdictions

To the extent that Ontario environmental requirements are in excess of those applied in jurisdictions where competitors are located, Ontario pulp and paper mills could be at a competitive disadvantage. Various types of environmental protection requirements in other jurisdictions (including the U.S. and OECD countries) have been reviewed by James F. Hickling Management Consultants (1990) who concluded that:

*"In our view, all the jurisdictions examined will continue to impose ever-more stringent regulation of industries' toxic pollutants."*

Moreover, the Hickling report states that Canadian-based companies have an advantage relative to their United States counterparts.

*"Firms operating in Canada, however, have a significant advantage over their U.S. counterparts in the Canadian federal government's accelerated capital cost allowance that the Canadian firms are permitted on their purchases of equipment for the purposes of pollution abatement and control. U.S. companies have no such comparable program"*

Comparing environmental standards and requirements among jurisdictions is not a simple matter. Standards and requirements are stated differently and there are various degrees of legality and enforceability. Moreover, while a nation or a jurisdiction may have strict standards and legislative requirements on the books, enforcement actions, or the lack of them, may result in little or no compliance. While regulatory regimes are not uniform or consistent in type or degree of stringency, there appears to be a general international movement towards higher degrees of regulatory standards and enforcement effort, with a variety of parameters and performance indicators being used to target the same group of environmental problems.

Compounding the difficulties of making precise international comparisons is the fact that standards for existing plants are often different from those for new plants. Moreover, standards or objectives are often not uniform between different products and sub-categories of the same industry. In most jurisdictions, standards for existing establishments are often negotiated on a plant by plant basis within a framework of regulatory targets.

Nonetheless, the Canadian situation as of the end of 1989 is described in a report commissioned by the Commission of the European Communities:

*"Although the Canadian approach seems very promising, especially the activities that are undertaken in Ontario, the overall impression is that Canada is behind most OECD countries in actually implementing environmental protection measures. For example, all U.S. mills basically employ secondary treatment or discharge through publicly-owned sewage treatment works; and many activated sludge plants are in operation. In Canada, this kind of technology is only coming into operation by 1993 as a result of these new effluent limitations. Canada is also behind many European countries, such as Finland, Sweden, and West Germany, in the regulation of the pulp and paper industry."* (COWI Consultants, 1990, Page 108).

As discussed earlier, U.S. mills are Ontario's major competition. Some 75%

Table 7.10

**COMPARISON OF AOX STANDARDS AND OBJECTIVES IN VARIOUS JURISDICTIONS**

| Jurisdiction | Target (Kg/Air Dried Tonne) | Year |
|---|---|---|
| **Sweden** | 1.0 (1)<br>0.5 (2) | 1995 |
| **W. Germany** | 1.0 | 1989 |
| **Finland** | 1.4 (3) | 1995 |
| **Australia** | 2.5 (4) | 1989 |
| **Quebec** | 1.0-2.5 | 1993-2000 |
| **Ontario (MCE)** | 0.75 | |
| **Ontario (MAX)** | 0.45 | |

(1) Annual average for mills using softwoods
(2) Annual average for mills using hardwoods
(3) National average
(4) Based on any one test

Sources: Bedma Consultants Inc 1991, McCubbin 1992, Water Resources Branch, MOE

of Ontario's pulp and paper output is sold to U. S. customers. It is important to note that the same study concludes that, out of 653 U.S. pulp and paper mills, only two lack the equivalent of secondary treatment. Up to the present time, chlorinated organic compounds, as measured by the AOX test, have not been subject to regulatory requirements or objectives. In addition, TSS and BOD guidelines for Ontario mills are less stringent than U.S. EPA requirements, although Ontario mills have achieved substantial reduction in TSS over the past decade. Nevertheless, in terms of BOD and TSS loading objectives, Ontario mills have lagged behind U.S. EPA requirements and industry accomplishments.

As an illustrative exercise, Bonsor, McCubbin and Sprague (1991) computed the discharges of conventional pollutants that would be allowed on the basis of U.S. EPA New Source Performance requirements for the 18 non-kraft mills in Ontario. This assessment revealed that three of the mills currently meet the EPA requirements for BOD and a fourth would almost do so. However, 17 of the 18 Ontario mills meet or come close to meeting the U.S. EPA requirements for TSS.

Unfortunately, the treatment or recovery of oxygen-demanding pollutants from a pulp mill offers little or no opportunity for saleable by-products or other input cost savings as has been the case with TSS recovery.

AOX and BOD and TSS standards for sulphate (kraft) mills in different jurisdictions are compared in Tables 7.10 and 7.11. For AOX, the technologies associated with the MCE option deliver

## Table 7.11

**COMPARISON OF BOD AND TSS STANDARDS OR OBJECTIVES FOR BLEACHED KRAFT MILLS**

| Jurisdiction | TSS (Kg/Air Dried Tonne) | BOD (Kg/Air Dried Tonne) | Year |
|---|---|---|---|
| **Australia** | 8 (1) | 7 (1) | 1989 |
| **Finland** | N/A | 8.2 | 1992 |
| **U.S.(Kraft)** | 4.8-14.3 | 3.1-8.4 | 1982 |
| **Canada (federal)** | 11.25 | 7.5 | 1995 |
| **Quebec** | 20 | 8 | 1995 |
| **Ontario (MCE)** | 1-2.25 | 0.5-1.0 | |
| **Ontario (MAX)** | 0.5-1.0 | 0.35-0.5 | |

(1) One day maximum

Sources: Bedma Consultants Inc 1991, McCubbin 1992, Water Resources Branch, MOE

final loadings in common with standards and objectives set in most jurisdictions. The MAX option delivers final AOX loadings that are significantly below standards and objectives set in other jurisdictions except Sweden which has given its mills until 1995 to reach a similar target.

BOD and TSS loading levels for sulphate (kraft) mills associated with both the MCE and the MAX Options are more stringent than standards set in other jurisdictions. Such stringent demands may impact negatively on Ontario mills' competitive position in that it forces mills to spend relatively more capital on environmental requirements and less on upgrading machinery and equipment needed to improve productivity than their competitors.

However, as competitiveness expert Michael Porter recently reported,

*"The conflict between environmental protection and economic competitiveness is a false dichotomy."*

In his book, The Competitive Advantage of Nations, Porter finds that the nations with the most rigorous requirements often lead in exports of affected products. According to Porter,

*Exacting standards seem at first blush to raise costs and make firms less competitive, particularly if competitors are from nations with fewer regulations. This may be true if everything stays the same except that expensive pollution-control equipment is added.*

*But everything will not stay the same. Properly constructed regulatory standards, which aim at outcomes and not methods, will encourage companies to re-engineer their technology. The result in many cases is a process that not only pollutes less but lowers costs or improves quality.*

### 7.7 Concluding Comments

Although environmental protection costs are just one of many factors that affect

competitiveness, potential MISA-related regulatory costs could influence the competitive circumstances facing Ontario pulp and paper mills.

Costs associated with the Most Cost Effective Control Option and the MISA monitoring requirements would not displace Eastern Canadian pulp mills from their current position as the third lowest cost producer. However, if the Maximum Removal Option costs were incurred, Eastern Canadian market pulp producers would be pushed from their third lowest cost position to the highest cost producer among the 7 regions examined.

For newsprint, neither BAT option raises total operating costs sufficiently to displace Canadian mills from their position as the second highest cost producers. However, the additional regulatory costs widens the gap that currently exists between Canadian and American producers.

The competitive position of Ontario pulp and paper mills rests largely on the U.S./Canadian dollar exchange rate. The value of Ontario shipments to the United States was approximately $2.2 billion in 1989. At an exchange rate of $1 Canadian = $0.87 U.S., and assuming shipments remain constant, a 1% depreciation in the U.S.-Canadian exchange rate would net the Ontario industry approximately $22,000,000 in additional revenue.

Consequently, it would require a depreciation of the Canadian dollar by 7% in order for the industry to accumulate added funds equal to the proposed annualized costs associated with the Maximum Removal Option plus the MISA monitoring requirements. An exchange rate depreciation of only 4% (less than 4 cents) would be necessary to generate extra revenue equal to the annualized cost of the Most Cost Effective Removal Option.

Operating costs of the Most Cost Effective Removal option amount to a modest 2% of total direct manufacturing costs for the Ontario pulp and paper industry while the total annualized regulatory costs are equivalent to 5% of total direct manufacturing costs. For the Maximum Removal Option, the percentages increase to 3% for estimated operating costs and 9% for total annualized costs.

The pulp and paper industry also faces a number of other issues which may require capital investments or which may further increase the cost of doing business in Ontario and Canada. These matters include timber management and regeneration, secondary fibre content requirements for newsprint and changing international trade conditions. Any one of these issues, including environmental protection requirements, might not have undue consequences for the industry but, taken together, they present the Ontario and Canadian pulp and paper industry with a challenge.

## Endnotes to Chapter 7

Calculation of Ontario Pulp and Paper Exports to the U.S.

Canadian Pulp and Paper Exports to the U.S., 1990 $10,688,045,000

| 1990 Production (000's tonnes) | Wood Pulp | Dist. | Paper | Dist. |
|---|---|---|---|---|
| Canada | 22,836 | 58% | 16,526 | 42% |
| Ontario | 4,188 | | 4,088 | |
| Ontario's % | 18.3 | | 24.7 | |

Ontario's Weighted Average of Canadian Production

58%(18.3) + 42%(24.7) = 21%

Ontario's Weighted Average of Pulp and Paper Exports to the U.S.

21% x $10,688,045,000 = $2.2 billion

Calculation of Exchange Rate Changes

| $Canadian | $U.S. Equivalent |
|---|---|
| 1.00 | 0.87 |
| 1.15 | 1.00 |
| 115 | 100 |
| 253 | 220 |
| 2,530 | 2,200 |

## Endnotes to Chapter 7

**1% decrease**

| $CAD | $U.S. Equivalent |
|---|---|
| 1.00 | 0.864 |
| 1.16 | 1.00 |
| 116 | 100 |
| 255.2 | 220 |
| 2,552 | 2,200 |

**4% decrease**

| $CAD | $U.S. Equivalent |
|---|---|
| 1.00 | 0.8354 |
| 1.197 | 1.00 |
| 119.7 | 100 |
| 263.34 | 220 |
| 2,633 | 2,200 |

**7% decrease**

| $CAD | $U.S. Equivalent |
|---|---|
| 1.00 | 0.81 |
| 1.236 | 1.00 |
| 123.6 | 100 |
| 271.9 | 220 |
| 2,719 | 2,200 |

# 8.0 SUMMARY

This report includes assessments of potential abatement programs that could be implemented at each pulp and paper mill subject to regulation. These potential programs do not, however, represent suggested regulatory limits or other requirements because these specific proposals were not developed when the present analyses were carried out.

These reports serve as a reference document of factual information as well as analytical results that can be used in the assessment of specific proposals. Moreover, the two abatement scenarios analyzed in this report are expected to encompass the cost range to pulp and paper mills that would be implemented by specific limits.

The primary objectives of the analyses presented in the report is to:

1) evaluate the cost-effectiveness of potential wastewater treatment and abatement program options;

2) show the incremental costs of successively higher levels of contaminant removal (lower levels of pollutant loadings in wastewaters); and

3) assess the financial and economic consequences of costs associated with potential abatement program options that are cost-effective plus other MISA related costs that may be incurred by regulated plants.

<u>**Cost Analyses of BAT Options**</u>

Five BAT options or technology trains have been identified for sulphate (kraft) pulping mills, four for deinking/board/fine papers/tissue mills while three BAT options have been defined for each of the sulphite-mechanical pulping and corrugating mills. Least-cost BAT options were identified and two combinations from this group were selected for further analysis.

One scenario is called the **Most Cost Effective** option based on the lowest average cost per kilogram of pollutants removed. This mix of technologies applied at each mill in the sector could remove 28,100 tonnes per year of the initial loadings of TSS (36,300 tonnes per year), 113,000 tonnes per year of BOD recorded loadings (117,400 tonnes per year) and 2,700 tonnes per year of the AOX loadings (3,900 tonnes per year) from sulphate (kraft) mills at a capital cost of $583 million and an annual operating cost of $54 million.

The second aggregate scenario represented the **Maximum Technically Achievable Removal** (MAX) option for the sector given available technology. Application of these technology combinations at each mill could reduce recorded TSS loadings by 31,400 tonnes per year, BOD loadings by 114,500 tonnes per year, and AOX loadings from the 9 sulphate (kraft) mills by 3,300 tonnes per year at a capital cost of $1.3 billion and an annual operating cost of $61 million.

Annualized costs and percentage reductions for each scenario are noted in the table below.

| COSTS AND REDUCTIONS | | | | |
|---|---|---|---|---|
| Option | Annualized Costs [1] (millions) | Percentage Reductions[2] | | |
| | | AOX | BOD | TSS |
| MCE | $94 | 70% | 96% | 77% |
| MAX | $181 | 85% | 98% | 86% |

Notes: [1] Capital and Operating Costs Annualized over 10 years at 12%
[2] Table does not specify actual limits

## Industry Trends and The Ability to Pass on Cost Increases

Ontario mills which are subject to MISA requirements produce output for 8 different product markets and employ over 17,000 people. The 3 primary product groups are newsprint, market pulp and fine papers. Each of these markets was analyzed to determine the ability of firms to pass through added regulatory costs as price increases.

Most of the market pulp produced by Ontario mills is exported to the U.S. Trade is facilitated by the absence of tariffs on incoming wood pulp to Canada, the United States or Britain. Consequently, prices for market pulp are determined in international markets over which pulp producers have little control.

While newsprint remains the dominant product of the Ontario industry, newsprint production has declined as a percentage of total Ontario paper production in the last 20 years. The majority of newsprint is exported to the U.S. where Ontario producers enjoy tariff-free trade but are subject to increasing competition from U.S and off-shore suppliers. Furthermore, the current economic recession has forced Ontario mills to reduce capacity utilization rates. These market conditions limit the ability of Ontario mills to pass on abatement costs as price increases.

Historically, domestic markets for fine paper, tissue and corrugating products have been tariff protected and supplied by relatively few producers. Consequently, prices could be maintained well above cost levels incurred by Canadian producers. However, disappearing trade barriers have lead to increased competition and has eroded firms' ability to effect price increases for most paper products. At the same time, diminishing trade barriers opens market opportunities to Canadian and Ontario producers including larger production runs and associated cost savings from economies of scale.

Under current economic conditions and market structures, the ability of Ontario pulp and paper mills to impose unilateral price increases on any of its product lines is severely limited. However, economic recovery and improved market conditions may permit price increases over the next 3-4 years that can recoup added costs.

It is also unlikely that individual Ontario firms could extract off-setting cost reductions from other input factors such as labour or raw materials.

## Financial Assessment of Regulatory Costs on Firms

Financial impact analyses utilized published financial data from Statistics Canada and consolidated financial reports of each company. Six pulp and paper firms which operate 14 mills in Ontario and for which the ministry had complete, published date for the years 1981-1990 were subject to these assessments.

The basic analytical approach used was to adjust or "shock" historical data with the relevant MISA related costs (and revenues, if any) to determine how each financial indicator would diverge from recorded values if the costs had been incurred during the relevant time period. Potential abatement plus MISA monitoring costs of each BAT option were used to make adjustments.

A second analysis was undertaken which incorporated the estimated costs to meet announced environmental regulations in other jurisdictions that were provided by four firms.

Using only Ontario MISA-related costs for both the MAX and the MCE levels of abatement, the analyses revealed that, if future financial performance mirrors the average performance over the last 10 years, generally, minor differences occur in financial ratios when adjusted to reflect the cost of the MCE option and the MAX option. Changes in measures of liquidity, solvency or profitability would range from little or no change for some indicators at one firm as a result of costs associated with the MCE level, to a 27 % reduction in profit at another company for the Maximum Removal Level costs.

However, should the poor financial performance registered since 1990 continue over the next several years, the imposition of abatement costs would exacerbate low returns or net losses that were sustained by several companies.

## Implications for Competitiveness

During recent years, the competitive position of Ontario pulp and paper mills and the firms that own them rests to a large degree on the unsteady foundations of U.S./Canadian dollar exchange rates. The value of Ontario shipments to the U.S. was approximately $2.2 billion in 1989. Assuming an exchange rate of $1 Canadian = 0.87 U.S. and that shipments remain constant, the Canadian dollar would have to depreciate by 7% (ie. the value of the U.S. dollar would rise by 7% in relation to the Canadian dollar) in order for the industry to accumulate funds equal to the proposed annualized costs associated with the Maximum Removal Level of abatement plus the MISA monitoring requirements.

On the other hand, an exchange rate depreciation of only 4% (less than 4 cents) would be necessary to generate extra revenue that is equivalent to the total annualized cost of the Most Cost Effective Removal Level.

Addition of costs associated with the Most Cost Effective Level of abatement plus the MISA monitoring requirements would not displace Eastern Canadian pulp mills from their current position as the third lowest-cost producer as determined by the Forest Sector Advisory Council. If the Maximum Removal Level costs were incurred, Eastern Canadian

market pulp producers would be pushed from their position as the third lowest-cost producer to the highest cost producer among the regions examined (i.e. U.S. South, U.S. West, Eastern Canada, B.C. Coast, B.C. Interior, Finland and Sweden).

Neither representative level of abatement costs (Maximum Removal or Most Cost-Effective Level) would raise total operating costs of newsprint producers sufficiently to displace Canadian mills from their position as the second highest cost producers as identified by the Forest Sector Advisory Council among the five nations or regions it compared (i.e. U.S. South, U.S. West, Sweden, Canada and Finland). However, the additional regulatory costs widens the gap in production costs that currently exists between Canadian producers and their main competitors, American producers.

The pulp and paper industry will also have to invest capital, or incur higher operating costs, in Ontario to accommodate

- greater levels of timber management and regeneration,
- increasing secondary fibre content requirements for newsprint and
- emerging competition from off-shore producers as trade barriers fall.

By themselves, any one of these issues might not have undue consequences for the industry. However, taken together, they present the Ontario and Canadian pulp and paper industry with a challenge.

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## APPENDIX A

## PLANT SPECIFIC ABATEMENT COST FUNCTIONS

## INITIAL LOADINGS, LOADING REDUCTIONS, FINAL LOADINGS AND COSTS OF BAT OPTIONS

Source: Best Available Technology for the Ontario Pulp and Paper Industry, N. McCubbin Consultants Inc., February 1992.

KRAFT SUBSECTOR – December 11, 1991

| SOURCE TREATMENT PLANS | FINAL LOADINGS BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | LOADING REDUCTIONS BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | COSTS CAPITAL | O&M | ANNUALIZED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| **BOISE CASCADE (Fort Frances)** | | | | | | | | | | | | | |
| Initial Loadings | 3,285 | 365 | 50 | 271 | 3,939 | 3,285 | 365 | 50 | 271 | 3,939 | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate Detectable Dioxins | 427 | 326 | 17 | 192 | 961 | 2,858 | 39 | 33 | 79 | 2,979 | 13.1 | 2.1 | 2.7 |
| K2 Eliminate Molecular Chlorine | 354 | 102 | 14 | 160 | 797 | 2,931 | 263 | 36 | 111 | 3,143 | 26.4 | 2.9 | 4.6 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 354 | 67 | 14 | 160 | 797 | 2,931 | 298 | 36 | 111 | 3,143 | 37.4 | 1.8 | 5.1 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 354 | 58 | 14 | 160 | 797 | 2,931 | 307 | 36 | 111 | 3,143 | 73.1 | (1.9) | 6.6 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | 177 | 47 | 14 | 177 | 354 | 3,108 | 318 | 36 | 94 | 3,585 | 113.0 | 3.5 | 14.1 |
| TOTALS FOR KRAFT SUBSECTOR | | | | | | | | | | | | | |
| Options | 2,641 | 3,141 | 109 | 1,258 | 5,805 | 31,911 | 788 | 133 | (249) | 16,134 | 266 | 10 | 34 |
| K1 Eliminate detectable Dioxins | 2,568 | 1,227 | 106 | 1,226 | 5,641 | 31,984 | 2,702 | 136 | (217) | 16,298 | 326 | 20 | 46 |
| K2 Eliminate Molecular Chlorine | 2,568 | 963 | 103 | 1,189 | 5,641 | 31,984 | 2,966 | 139 | (180) | 16,298 | 427 | 9 | 51 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 2,568 | 781 | 101 | 1,171 | 5,641 | 31,984 | 3,148 | 141 | (162) | 16,298 | 770 | (16) | 72 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 1,709 | 656 | 101 | 1,211 | 3,492 | 32,843 | 3,273 | 141 | (202) | 18,446 | 1,020 | 24 | 123 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | | | | | | | | | | | | | |

KRAFT SUBSECTOR – December 11, 1991

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | | LOADING REDUCTIONS | | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | CAPITAL | O&M | ANNUALIZED |
| | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| **CPFP (Dryden)** | | | | | | | | | | | | | |
| Initial Loadings | 1,143 | 837 | 66 | 64 | 2,016 | 1,143 | 837 | 66 | 64 | 2,016 | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate Detectable Dioxins | 352 | 508 | 14 | 158 | 793 | 791 | 329 | 52 | (94) | 1,224 | 12.3 | 1.6 | 2.2 |
| K2 Eliminate Molecular Chlorine | 352 | 175 | 14 | 158 | 793 | 791 | 662 | 52 | (94) | 1,224 | 19.0 | 3.0 | 3.8 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 352 | 130 | 14 | 158 | 793 | 791 | 707 | 52 | (94) | 1,224 | 33.8 | 1.9 | 4.7 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 352 | 115 | 14 | 158 | 793 | 791 | 722 | 52 | (94) | 1,224 | 74.7 | 0.6 | 8.3 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | 176 | 108 | 14 | 158 | 352 | 967 | 729 | 52 | (94) | 1,664 | 119.1 | 7.7 | 17.3 |
| TOTALS FOR KRAFT SUBSECTOR | | | | | | | | | | | | | |
| Options | 2,641 | 3,141 | 109 | 1,258 | 5,805 | 31,911 | 788 | 133 | (249) | 16,134 | 266 | 10 | 34 |
| K1 Eliminate detectable Dioxins | 2,568 | 1,227 | 106 | 1,226 | 5,641 | 31,984 | 2,702 | 136 | (217) | 16,298 | 326 | 20 | 46 |
| K2 Eliminate Molecular Chlorine | 2,568 | 963 | 103 | 1,189 | 5,641 | 31,984 | 2,966 | 139 | (180) | 16,298 | 427 | 9 | 51 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 2,568 | 781 | 101 | 1,171 | 5,641 | 31,984 | 3,148 | 141 | (162) | 16,298 | 770 | (16) | 72 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 1,709 | 656 | 101 | 1,211 | 3,492 | 32,843 | 3,273 | 141 | (202) | 18,446 | 1,020 | 24 | 123 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | | | | | | | | | | | | | |

KRAFT SUBSECTOR – December 11, 1991

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | | LOADING REDUCTIONS | | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | CAPITAL | O&M | ANNUALIZED |
| | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| **CPFP (T. Bay)** | | | | | | | | | | | | | |
| Initial Loadings | 7,589 | 979 | 43 | 92 | 5,840 | 7,589 | 979 | 43 | 92 | 5,840 | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate Detectable Dioxins | 418 | 872 | 15 | 183 | 836 | 7,171 | 107 | 28 | (91) | 5,004 | 38.8 | 3.9 | 6.5 |
| K2 Eliminate Molecular Chlorine | 418 | 348 | 15 | 183 | 836 | 7,171 | 631 | 28 | (91) | 5,004 | 38.8 | 5.8 | 7.6 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 418 | 280 | 12 | 146 | 836 | 7,171 | 699 | 31 | (54) | 5,004 | 63.9 | 2.4 | 8.2 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 418 | 236 | 10 | 128 | 836 | 7,171 | 743 | 33 | (36) | 5,004 | 125.4 | (0.6) | 13.0 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | 418 | 207 | 10 | 128 | 836 | 7,171 | 772 | 33 | (36) | 5,004 | 153.3 | 3.7 | 18.5 |
| TOTALS FOR KRAFT SUBSECTOR | | | | | | | | | | | | | |
| Options | 2,641 | 3,141 | 109 | 1,258 | 5,805 | 31,911 | 788 | 133 | (249) | 16,134 | 266 | 10 | 34 |
| K1 Eliminate detectable Dioxins | 2,568 | 1,227 | 106 | 1,226 | 5,641 | 31,984 | 2,702 | 136 | (217) | 16,298 | 326 | 20 | 46 |
| K2 Eliminate Molecular Chlorine | 2,568 | 963 | 103 | 1,189 | 5,641 | 31,984 | 2,966 | 139 | (180) | 16,298 | 427 | 9 | 51 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 2,568 | 781 | 101 | 1,171 | 5,641 | 31,984 | 3,148 | 141 | (162) | 16,298 | 770 | (16) | 72 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 1,709 | 656 | 101 | 1,211 | 3,492 | 32,843 | 3,273 | 141 | (202) | 18,446 | 1,020 | 24 | 123 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | | | | | | | | | | | | | |

| SOURCE TREATMENT PLANS | FINAL LOADINGS BOD | FINAL LOADINGS AOX | FINAL LOADINGS Phosphorus | FINAL LOADINGS Kjeldahl Nitrogen | FINAL LOADINGS TSS | LOADING REDUCTIONS BOD | LOADING REDUCTIONS AOX | LOADING REDUCTIONS Phosphorus | LOADING REDUCTIONS Kjeldahl Nitrogen | LOADING REDUCTIONS TSS | COSTS CAPITAL | COSTS O&M | COSTS ANNUALIZED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| **DOMTAR INC. (Cornwall)** | | | | | | | | | | | | | |
| Initial Loadings | 8,049 | 146 | 16 | 130 | 3,801 | 8,049 | 146 | 16 | 130 | 3,801 | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate Detectable Dioxins | 132 | 86 | 11 | 133 | 265 | 7,917 | 60 | 5 | (3) | 3,536 | 82.8 | (3.2) | 6.8 |
| K2 Eliminate Molecular Chlorine | 132 | 69 | 11 | 133 | 265 | 7,917 | 77 | 5 | (3) | 3,536 | 84.5 | (2.8) | 7.3 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 132 | 54 | 11 | 133 | 265 | 7,917 | 92 | 5 | (3) | 3,536 | 93.1 | (3.5) | 7.8 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 132 | 37 | 11 | 133 | 265 | 7,917 | 110 | 5 | (3) | 3,536 | 116.6 | (6.5) | 8.5 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | 132 | 26 | 11 | 133 | 265 | 7,917 | 120 | 5 | (3) | 3,536 | 129.4 | (4.4) | 11.1 |
| TOTALS FOR KRAFT SUBSECTOR | | | | | | | | | | | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate detectable Dioxins | 2,641 | 3,141 | 109 | 1,258 | 5,805 | 31,911 | 788 | 133 | (249) | 16,134 | 266 | 10 | 34 |
| K2 Eliminate Molecular Chlorine | 2,568 | 1,227 | 106 | 1,226 | 5,641 | 31,984 | 2,702 | 136 | (217) | 16,298 | 326 | 20 | 46 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 2,568 | 963 | 103 | 1,189 | 5,641 | 31,984 | 2,966 | 139 | (180) | 16,298 | 427 | 9 | 51 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 2,568 | 781 | 101 | 1,171 | 5,641 | 31,984 | 3,148 | 141 | (162) | 16,298 | 770 | (16) | 72 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | 1,709 | 656 | 101 | 1,211 | 3,492 | 32,843 | 3,273 | 141 | (202) | 18,446 | 1,020 | 24 | 123 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | | LOADING REDUCTIONS | | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | CAPITAL | O&M | ANNUALIZED |
| | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| **DOMTAR INC. (Red Rock)** | | | | | | | | | | | | | |
| Initial Loadings | 5,736 | 62 | 8 | 65 | 2,285 | 5,736 | 62 | 8 | 65 | 2,285 | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate Detectable Dioxins | 299 | 33 | 12 | 135 | 673 | 5,437 | 29 | (4) | (70) | 1,612 | 43.3 | 0.2 | 4.7 |
| K2 Eliminate Molecular Chlorine | 299 | 7 | 12 | 135 | 673 | 5,437 | 54 | (4) | (70) | 1,612 | 48.5 | 0.5 | 5.5 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 299 | 0 | 12 | 135 | 673 | 5,437 | 62 | (4) | (70) | 1,612 | 45.4 | 0.4 | 5.1 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 0.0 | 0.0 | 0.0 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 0.0 | 0.0 | 0.0 |
| TOTALS FOR KRAFT SUBSECTOR | | | | | | | | | | | | | |
| Options | 2,641 | 3,141 | 109 | 1,258 | 5,805 | 31,911 | 788 | 133 | (249) | 16,134 | 266 | 10 | 34 |
| K1 Eliminate detectable Dioxins | 2,568 | 1,227 | 106 | 1,226 | 5,641 | 31,984 | 2,702 | 136 | (217) | 16,298 | 326 | 20 | 46 |
| K2 Eliminate Molecular Chlorine | 2,568 | 963 | 103 | 1,189 | 5,641 | 31,984 | 2,966 | 139 | (180) | 16,298 | 427 | 9 | 51 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 2,568 | 781 | 101 | 1,171 | 5,641 | 31,984 | 3,148 | 141 | (162) | 16,298 | 770 | (16) | 72 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 1,709 | 656 | 101 | 1,211 | 3,492 | 32,843 | 3,273 | 141 | (202) | 18,446 | 1,020 | 24 | 123 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | | | | | | | | | | | | | |

| SOURCE TREATMENT PLANS | FINAL LOADINGS BOD | FINAL LOADINGS AOX | FINAL LOADINGS Phosphorus | FINAL LOADINGS Kjeldahl Nitrogen | FINAL LOADINGS TSS | LOADING REDUCTIONS BOD | LOADING REDUCTIONS AOX | LOADING REDUCTIONS Phosphorus | LOADING REDUCTIONS Kjeldahl Nitrogen | LOADING REDUCTIONS TSS | COSTS CAPITAL | COSTS O&M | COSTS ANNUALIZED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| **E.B EDDY (Espanola)** | | | | | | | | | | | | | |
| Initial Loadings | 616 | 307 | 20 | 119 | 1,002 | 616 | 307 | 20 | 119 | 1,002 | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate Detectable Dioxins | 344 | 307 | 14 | 155 | 774 | 272 | 0 | 6 | (36) | 227 | 15.8 | 0.4 | 1.9 |
| K2 Eliminate Molecular Chlorine | 344 | 128 | 14 | 155 | 774 | 272 | 179 | 6 | (36) | 227 | 35.5 | 2.0 | 5.0 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 344 | 128 | 14 | 155 | 774 | 272 | 179 | 6 | (36) | 227 | 35.5 | 2.0 | 5.0 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 344 | 79 | 14 | 155 | 774 | 272 | 228 | 6 | (36) | 227 | 119.9 | (1.9) | 11.6 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | 172 | 79 | 14 | 173 | 344 | 444 | 228 | 6 | (54) | 658 | 146.7 | 6.9 | 19.7 |
| TOTALS FOR KRAFT SUBSECTOR | | | | | | | | | | | | | |
| Options | 2,641 | 3,141 | 109 | 1,258 | 5,805 | 31,911 | 788 | 133 | (249) | 16,134 | 266 | 10 | 34 |
| K1 Eliminate detectable Dioxins | 2,568 | 1,227 | 106 | 1,226 | 5,641 | 31,984 | 2,702 | 136 | (217) | 16,298 | 326 | 20 | 46 |
| K2 Eliminate Molecular Chlorine | 2,568 | 963 | 103 | 1,189 | 5,641 | 31,984 | 2,966 | 139 | (180) | 16,298 | 427 | 9 | 51 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 2,568 | 781 | 101 | 1,171 | 5,641 | 31,984 | 3,148 | 141 | (162) | 16,298 | 770 | (16) | 72 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 1,709 | 656 | 101 | 1,211 | 3,492 | 32,843 | 3,273 | 141 | (202) | 18,446 | 1,020 | 24 | 123 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | | | | | | | | | | | | | |

| SOURCE TREATMENT PLANS | FINAL LOADINGS BOD | FINAL LOADINGS AOX | FINAL LOADINGS Phosphorus | FINAL LOADINGS Kjeldahl Nitrogen | FINAL LOADINGS TSS | LOADING REDUCTIONS BOD | LOADING REDUCTIONS AOX | LOADING REDUCTIONS Phosphorus | LOADING REDUCTIONS Kjeldahl Nitrogen | LOADING REDUCTIONS TSS | COSTS CAPITAL | COSTS O&M | COSTS ANNUALIZED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| **JAMES RIVER (Marathon)** | | | | | | | | | | | | | |
| Initial Loadings | 4,586 | 310 | 15 | 70 | 941 | 4,586 | 310 | 15 | 70 | 941 | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate Detectable Dioxins | 155 | 294 | 6 | 70 | 349 | 4,431 | 16 | 9 | (0) | 592 | 23.5 | 1.3 | 3.3 |
| K2 Eliminate Molecular Chlorine | 155 | 107 | 6 | 70 | 349 | 4,431 | 203 | 9 | (0) | 592 | 31.2 | 2.7 | 4.9 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 155 | 85 | 6 | 70 | 349 | 4,431 | 225 | 9 | (0) | 592 | 41.1 | 1.9 | 5.5 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 155 | 54 | 6 | 70 | 349 | 4,431 | 256 | 9 | (0) | 592 | 65.3 | (2.2) | 5.6 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | 78 | 40 | 6 | 70 | 155 | 4,508 | 270 | 9 | (0) | 786 | 85.6 | 1.2 | 9.8 |
| TOTALS FOR KRAFT SUBSECTOR | | | | | | | | | | | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate detectable Dioxins | 2,641 | 3,141 | 109 | 1,258 | 5,805 | 31,911 | 788 | 133 | (249) | 16,134 | 266 | 10 | 34 |
| K2 Eliminate Molecular Chlorine | 2,568 | 1,227 | 106 | 1,226 | 5,641 | 31,984 | 2,702 | 136 | (217) | 16,298 | 326 | 20 | 46 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 2,568 | 963 | 103 | 1,189 | 5,641 | 31,984 | 2,966 | 139 | (180) | 16,298 | 427 | 9 | 51 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 2,568 | 781 | 101 | 1,171 | 5,641 | 31,984 | 3,148 | 141 | (162) | 16,298 | 770 | (16) | 72 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | 1,709 | 656 | 101 | 1,211 | 3,492 | 32,843 | 3,273 | 141 | (202) | 18,446 | 1,020 | 24 | 123 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | | LOADING REDUCTIONS | | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | CAPITAL | O&M | ANNUALIZED |
| | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| **KIMBERLY–CLARK (Terrace Bay)** | | | | | | | | | | | | | |
| Initial Loadings | 514 | 705 | 18 | 161 | 1,562 | 514 | 705 | 18 | 161 | 1,562 | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate Detectable Dioxins | 405 | 555 | 16 | 183 | 912 | 109 | 150 | 2 | (22) | 650 | 11.9 | 2.0 | 2.5 |
| K2 Eliminate Molecular Chlorine | 405 | 229 | 16 | 183 | 912 | 109 | 476 | 2 | (22) | 650 | 17.3 | 3.3 | 3.8 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 405 | 174 | 16 | 183 | 912 | 109 | 531 | 2 | (22) | 650 | 45.3 | 1.0 | 5.4 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 405 | 163 | 16 | 183 | 912 | 109 | 542 | 2 | (22) | 650 | 97.5 | (4.8) | 7.4 |
| K5 Eliminate Molecular Chlorine | 203 | 114 | 16 | 183 | 405 | 311 | 591 | 2 | (22) | 1,157 | 158.6 | 1.1 | 17.5 |
| TOTALS FOR KRAFT SUBSECTOR | | | | | | | | | | | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate detectable Dioxins | 2,641 | 3,141 | 109 | 1,258 | 5,805 | 31,911 | 788 | 133 | (249) | 16,134 | 266 | 10 | 34 |
| K2 Eliminate Molecular Chlorine | 2,568 | 1,227 | 106 | 1,226 | 5,641 | 31,984 | 2,702 | 136 | (217) | 16,298 | 326 | 20 | 46 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 2,568 | 963 | 103 | 1,189 | 5,641 | 31,984 | 2,966 | 139 | (180) | 16,298 | 427 | 9 | 51 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 2,568 | 781 | 101 | 1,171 | 5,641 | 31,984 | 3,148 | 141 | (162) | 16,298 | 770 | (16) | 72 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | 1,709 | 656 | 101 | 1,211 | 3,492 | 32,843 | 3,273 | 141 | (202) | 18,446 | 1,020 | 24 | 123 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | LOADING REDUCTIONS BOD | AOX | Phosphorus | Kjeldahl Nitrogen | TSS | COSTS CAPITAL | O&M | ANNUALIZED |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| **MALETTE INC.** | | | | | | | | | | | | | |
| Initial Loadings | 3,033 | 218 | 7 | 38 | 552 | 3,033 | 218 | 7 | 38 | 552 | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate Detectable Dioxins | 108 | 160 | 4 | 49 | 243 | 2,925 | 58 | 3 | (11) | 309 | 24.9 | 1.9 | 3.8 |
| K2 Eliminate Molecular Chlorine | 108 | 61 | 4 | 49 | 243 | 2,925 | 157 | 3 | (11) | 309 | 24.9 | 2.2 | 4.0 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 108 | 45 | 4 | 49 | 243 | 2,925 | 173 | 3 | (11) | 309 | 31.7 | 1.5 | 4.3 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 108 | 40 | 4 | 49 | 243 | 2,925 | 178 | 3 | (11) | 309 | 52.2 | 1.3 | 6.3 |
| K5 Eliminate Molecular Chlorine | 54 | 34 | 4 | 54 | 108 | 2,979 | 184 | 3 | (16) | 444 | 69.0 | 4.1 | 9.8 |
| TOTALS FOR KRAFT SUBSECTOR | | | | | | | | | | | | | |
| Options | | | | | | | | | | | | | |
| K1 Eliminate detectable Dioxins | 2,641 | 3,141 | 109 | 1,258 | 5,805 | 31,911 | 788 | 133 | (249) | 16,134 | 266 | 10 | 34 |
| K2 Eliminate Molecular Chlorine | 2,568 | 1,227 | 106 | 1,226 | 5,641 | 31,984 | 2,702 | 136 | (217) | 16,298 | 326 | 20 | 46 |
| K3 Eliminate Molecular Chlorine (Including Oxygen Delignification) | 2,568 | 963 | 103 | 1,189 | 5,641 | 31,984 | 2,966 | 139 | (180) | 16,298 | 427 | 9 | 51 |
| K4 Eliminate Molecular Chlorine (Including Extended Cooking) | 2,568 | 781 | 101 | 1,171 | 5,641 | 31,984 | 3,148 | 141 | (162) | 16,298 | 770 | (16) | 72 |
| K5 Eliminate Molecular Chlorine (Inc. Ext. Cooking & Oxy. Delignification) | 1,709 | 656 | 101 | 1,211 | 3,492 | 32,843 | 3,273 | 141 | (202) | 18,446 | 1,020 | 24 | 123 |

SULPHITE/ MECHANICAL SUBSECTOR – December 11, 1991

| | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SOURCE TREATMENT PLANS | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZE |
| **ABITIBI – PRICE (Provincial Papers)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 582 | 1,541 | 2 | 20 | 582 | 1,541 | 2 | 20 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 155 | 77 | 6 | 77 | 427 | 1,463 | (4) | (57) | 17.1 | 1.8 | 2.9 |
| S2 AST plus Sand Filter | 77 | 54 | 3 | N/A | 505 | 1,487 | (1) | N/A | 22.3 | 1.8 | 3.5 |
| S3 AST plus chemically assisted coagulation | 77 | 54 | 3 | N/A | 505 | 1,487 | (1) | N/A | 20.8 | 2.3 | 3.6 |
| TOTALS for the Sulphite Subsector | | | | | | | | | | | |
| Initial Loadings | 11,895 | 63,806 | 54 | 271 | 11,895 | 63,806 | 54 | 271 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 1,943 | 971 | 74 | 884 | 9,952 | 62,835 | (21) | (613) | 198.4 | 25.7 | 36.5 |
| S2 AST plus Sand Filter | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 255.3 | 27.9 | 43.8 |
| S3 AST plus chemically assisted coagulation | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 238.2 | 33.6 | 45.4 |

| | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SOURCE TREATMENT PLANS | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZE |
| **ABITIBI – PRICE (Iroquois Falls)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 2,783 | 20,373 | 12 | 71 | 2,783 | 20,373 | 12 | 71 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 292 | 146 | 12 | 146 | 2,491 | 20,227 | 0 | (75) | 42.6 | 6.2 | 8.2 |
| S2 AST plus Sand Filter | 146 | 102 | 6 | N/A | 2,637 | 20,271 | 6 | N/A | 50.9 | 6.5 | 9.3 |
| S3 AST plus chemically assisted coagulation | 146 | 102 | 6 | N/A | 2,637 | 20,271 | 6 | N/A | 48.4 | 7.4 | 9.6 |
| TOTALS for the Sulphite Subsector | | | | | | | | | | | |
| Initial Loadings | 11,895 | 63,806 | 54 | 271 | 11,895 | 63,806 | 54 | 271 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 1,943 | 971 | 74 | 884 | 9,952 | 62,835 | (21) | (613) | 198.4 | 25.7 | 36.5 |
| S2 AST plus Sand Filter | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 255.3 | 27.9 | 43.8 |
| S3 AST plus chemically assisted coagulation | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 238.2 | 33.6 | 45.4 |

SULPHITE/ MECHANICAL SUBSECTOR – December 11, 1991

| SOURCE TREATMENT PLANS | FINAL LOADINGS TSS | FINAL LOADINGS BOD | FINAL LOADINGS Phosphorus | FINAL LOADINGS Kjeldahl Nitrogen | LOADING REDUCTIONS TSS | LOADING REDUCTIONS BOD | LOADING REDUCTIONS Phosphorus | LOADING REDUCTIONS Kjeldahl Nitrogen | COSTS CAPITAL | COSTS O&M | COSTS ANNUALIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ABITIBI – PRICE (Thunder Bay)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 695 | 9,981 | 3 | 28 | 695 | 9,981 | 3 | 28 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 172 | 86 | 7 | 86 | 523 | 9,894 | (4) | (58) | 31.1 | 3.9 | 5.7 |
| S2 AST plus Sand Filter | 86 | 60 | 3 | N/A | 609 | 9,920 | 0 | N/A | 36.6 | 4.1 | 6.3 |
| S3 AST plus chemically assisted coagulation | 86 | 60 | 3 | N/A | 609 | 9,920 | 0 | N/A | 35.0 | 4.6 | 6.5 |
| TOTALS for the Sulphite Subsector | | | | | | | | | | | |
| Initial Loadings | 11,895 | 63,806 | 54 | 271 | 11,895 | 63,806 | 54 | 271 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 1,943 | 971 | 74 | 884 | 9,952 | 62,835 | (21) | (613) | 198.4 | 25.7 | 36.5 |
| S2 AST plus Sand Filter | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 255.3 | 27.9 | 43.8 |
| S3 AST plus chemically assisted coagulation | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 238.2 | 33.6 | 45.4 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS TSS | FINAL LOADINGS BOD | FINAL LOADINGS Phosphorus | FINAL LOADINGS Kjeldahl Nitrogen | LOADING REDUCTIONS TSS | LOADING REDUCTIONS BOD | LOADING REDUCTIONS Phosphorus | LOADING REDUCTIONS Kjeldahl Nitrogen | COSTS CAPITAL | COSTS O&M | COSTS ANNUALIZE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ABITIBI – PRICE (Ft. William)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 434 | 5,118 | 4 | 27 | 434 | 5,118 | 4 | 27 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 135 | 68 | 6 | 68 | 299 | 5,051 | (2) | (40) | 20.6 | 2.6 | 3.8 |
| S2 AST plus Sand Filter | 68 | 48 | 3 | N/A | 366 | 5,070 | 1 | N/A | 25.2 | 2.8 | 4.4 |
| S3 AST plus chemically assisted coagulation | 68 | 48 | 3 | N/A | 366 | 5,070 | 1 | N/A | 23.9 | 3.2 | 4.5 |
| TOTALS for the Sulphite Subsector | | | | | | | | | | | |
| Initial Loadings | 11,895 | 63,806 | 54 | 271 | 11,895 | 63,806 | 54 | 271 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 1,943 | 971 | 74 | 884 | 9,952 | 62,835 | (21) | (613) | 198.4 | 25.7 | 36.5 |
| S2 AST plus Sand Filter | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 255.3 | 27.9 | 43.8 |
| S3 AST plus chemically assisted coagulation | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 238.2 | 33.6 | 45.4 |

SULPHITE/ MECHANICAL SUBSECTOR – December 11, 1991

| | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SOURCE TREATMENT PLANS | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZE |
| **BOISE CASCADE (Kenora)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 1,252 | 12,734 | 5 | 40 | 1,252 | 12,734 | 5 | 40 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 339 | 170 | 14 | 170 | 913 | 12,565 | (9) | (130) | 32.6 | 4.6 | 6.2 |
| S2 AST plus Sand Filter | 170 | 119 | 7 | N/A | 1,082 | 12,616 | (2) | N/A | 41.8 | 5.1 | 7.5 |
| S3 AST plus chemically assisted coagulation | 170 | 119 | 7 | N/A | 1,082 | 12,616 | (2) | N/A | 39.0 | 6.1 | 7.8 |
| TOTALS for the Sulphite Subsector | | | | | | | | | | | |
| Initial Loadings | 11,895 | 63,806 | 54 | 271 | 11,895 | 63,806 | 54 | 271 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 1,943 | 971 | 74 | 884 | 9,952 | 62,835 | (21) | (613) | 198.4 | 25.7 | 36.5 |
| S2 AST plus Sand Filter | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 255.3 | 27.9 | 43.8 |
| S3 AST plus chemically assisted coagulation | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 238.2 | 33.6 | 45.4 |

| | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SOURCE TREATMENT PLANS | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZE |
| **QUEBEC AND ONTARIO (Thorold)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 1,070 | 414 | 9 | 66 | 1,070 | 414 | 9 | 66 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 307 | 153 | 9 | 66 | 763 | 261 | 0 | 0 | 3.8 | 0.1 | 0.5 |
| S2 AST plus Sand Filter | 153 | 107 | 8 | N/A | 917 | 307 | 1 | N/A | 12.4 | 0.5 | 1.6 |
| S3 AST plus chemically assisted coagulation | 153 | 107 | 8 | N/A | 917 | 307 | 1 | N/A | 9.8 | 1.4 | 1.9 |
| TOTALS for the Sulphite Subsector | | | | | | | | | | | |
| Initial Loadings | 11,895 | 63,806 | 54 | 271 | 11,895 | 63,806 | 54 | 271 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 1,943 | 971 | 74 | 884 | 9,952 | 62,835 | (21) | (613) | 198.4 | 25.7 | 36.5 |
| S2 AST plus Sand Filter | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 255.3 | 27.9 | 43.8 |
| S3 AST plus chemically assisted coagulation | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 238.2 | 33.6 | 45.4 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZE |
| **ST. MARYS (Sault Ste Marie)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 2,194 | 2,081 | 9 | 14 | 2,194 | 2,081 | 9 | 14 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 185 | 92 | 7 | 92 | 2,010 | 1,989 | 2 | (79) | 15.6 | 2.0 | 2.8 |
| S2 AST plus Sand Filter | 92 | 65 | 4 | N/A | 2,102 | 2,016 | 5 | N/A | 21.4 | 2.2 | 3.6 |
| S3 AST plus chemically assisted coagulation | 92 | 65 | 4 | N/A | 2,102 | 2,016 | 5 | N/A | 19.7 | 2.7 | 3.7 |
| TOTALS for the Sulphite Subsector | | | | | | | | | | | |
| Initial Loadings | 11,895 | 63,806 | 54 | 271 | 11,895 | 63,806 | 54 | 271 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 1,943 | 971 | 74 | 884 | 9,952 | 62,835 | (21) | (613) | 198.4 | 25.7 | 36.5 |
| S2 AST plus Sand Filter | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 255.3 | 27.9 | 43.8 |
| S3 AST plus chemically assisted coagulation | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 238.2 | 33.6 | 45.4 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZE |
| **SPRUCE FALLS (Kapuskasing)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 2,884 | 11,564 | 9 | 4 | 2,884 | 11,564 | 9 | 4 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 357 | 178 | 14 | 178 | 2,527 | 11,385 | (5) | (174) | 34.9 | 4.5 | 6.4 |
| S2 AST plus Sand Filter | 178 | 125 | 7 | N/A | 2,705 | 11,439 | 2 | N/A | 44.6 | 4.9 | 7.7 |
| S3 AST plus chemically assisted coagulation | 178 | 125 | 7 | N/A | 2,705 | 11,439 | 2 | N/A | 41.6 | 5.9 | 8.0 |
| TOTALS for the Sulphite Subsector | | | | | | | | | | | |
| Initial Loadings | 11,895 | 63,806 | 54 | 271 | 11,895 | 63,806 | 54 | 271 | | | |
| Options | | | | | | | | | | | |
| S1 Exemplary activated Sludge | 1,943 | 971 | 74 | 884 | 9,952 | 62,835 | (21) | (613) | 198.4 | 25.7 | 36.5 |
| S2 AST plus Sand Filter | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 255.3 | 27.9 | 43.8 |
| S3 AST plus chemically assisted coagulation | 972 | 680 | 42 | N/A | 10,923 | 63,126 | 12 | N/A | 238.2 | 33.6 | 45.4 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZED |
| **BEAVER WOOD FIBRE COMPANY** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 277 | 640 | 0 | 12 | 277 | 640 | 0 | 12 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 185 | 82 | 3 | 37 | 92 | 558 | (3) | (25) | 3.4 | 0.3 | 0.6 |
| F2 AST plus Sand Filter | 82 | 41 | 3 | 41 | 195 | 599 | (3) | (29) | 7.4 | 1.0 | 1.4 |
| F3 AST plus chemically assisted coagulation | 41 | 29 | 2 | N/A | 236 | 611 | (2) | N/A | 10.6 | 1.2 | 1.8 |
| F4 AST with granular filtration | 41 | 29 | 2 | N/A | 236 | 611 | (2) | N/A | 9.7 | 1.4 | 1.9 |
| TOTALS for Fine Paper Subsector | | | | | | | | | | | |
| Initial Loadings | 1,300 | 3,581 | 3 | 70 | 1,300 | 3,581 | 3 | 70 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 575 | 378 | 15 | 187 | 726 | 3,203 | (12) | (116) | 30.9 | 4.0 | 5.7 |
| F2 AST plus Sand Filter | 377 | 296 | 14 | 152 | 924 | 3,284 | (12) | (82) | 42.6 | 6.3 | 8.3 |
| F3 AST plus chemically assisted coagulation | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 57.3 | 6.8 | 10.2 |
| F4 AST with granular filtration | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 53.2 | 7.8 | 10.4 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZED |
| **DOMTAR INC (St Catherines)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 154 | 435 | 0 | 7 | 154 | 435 | 0 | 7 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 59 | 30 | 2 | 30 | 95 | 405 | (2) | (22) | 6.5 | 1.0 | 1.3 |
| F2 AST plus Sand Filter | 59 | 30 | 2 | 30 | 95 | 405 | (2) | (22) | 6.5 | 1.0 | 1.3 |
| F3 AST plus chemically assisted coagulation | 30 | 20 | 1 | N/A | 124 | 415 | (1) | N/A | 9.0 | 1.1 | 1.6 |
| F4 AST with granular filtration | 30 | 20 | 1 | N/A | 124 | 415 | (1) | N/A | 8.3 | 1.2 | 1.6 |
| TOTALS for Fine Paper Subsector | | | | | | | | | | | |
| Initial Loadings | 1,300 | 3,581 | 3 | 70 | 1,300 | 3,581 | 3 | 70 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 575 | 378 | 15 | 187 | 726 | 3,203 | (12) | (116) | 30.9 | 4.0 | 5.7 |
| F2 AST plus Sand Filter | 377 | 296 | 14 | 152 | 924 | 3,284 | (12) | (82) | 42.6 | 6.3 | 8.3 |
| F3 AST plus chemically assisted coagulation | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 57.3 | 6.8 | 10.2 |
| F4 AST with granular filtration | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 53.2 | 7.8 | 10.4 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZED |
| **E.B. EDDY (Ottawa)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 204 | 429 | 0 | 11 | 204 | 429 | 0 | 11 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 65 | 32 | 3 | 32 | 140 | 397 | (3) | (21) | 6.8 | 1.0 | 1.3 |
| F2 AST plus Sand Filter | 65 | 32 | 3 | 0 | 140 | 397 | (3) | 11 | 6.8 | 1.0 | 1.3 |
| F3 AST plus chemically assisted coagulation | 32 | 23 | 1 | N/A | 172 | 406 | (1) | N/A | 9.5 | 1.1 | 1.7 |
| F4 AST with granular filtration | 32 | 23 | 1 | N/A | 172 | 406 | (1) | N/A | 8.7 | 1.3 | 1.7 |
| TOTALS for Fine Paper Subsector | | | | | | | | | | | |
| Initial Loadings | 1,300 | 3,581 | 3 | 70 | 1,300 | 3,581 | 3 | 70 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 575 | 378 | 15 | 187 | 726 | 3,203 | (12) | (116) | 30.9 | 4.0 | 5.7 |
| F2 AST plus Sand Filter | 377 | 296 | 14 | 152 | 924 | 3,284 | (12) | (82) | 42.6 | 6.3 | 8.3 |
| F3 AST plus chemically assisted coagulation | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 57.3 | 6.8 | 10.2 |
| F4 AST with granular filtration | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 53.2 | 7.8 | 10.4 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZED |
| **NORANDA (Thorold)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 365 | 1,181 | 1 | 11 | 365 | 1,181 | 1 | 11 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 99 | 49 | 4 | 49 | 266 | 1,132 | (3) | (38) | 10.7 | 1.3 | 1.9 |
| F2 AST plus Sand Filter | 99 | 49 | 4 | 49 | 266 | 1,132 | (3) | (38) | 10.7 | 1.3 | 1.9 |
| F3 AST plus chemically assisted coagulation | 49 | 34 | 2 | N/A | 316 | 1,147 | (2) | N/A | 14.3 | 1.4 | 2.4 |
| F4 AST with granular filtration | 49 | 34 | 2 | N/A | 316 | 1,147 | (2) | N/A | 13.3 | 1.7 | 2.5 |
| TOTALS for Fine Paper Subsector | | | | | | | | | | | |
| Initial Loadings | 1,300 | 3,581 | 3 | 70 | 1,300 | 3,581 | 3 | 70 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 575 | 378 | 15 | 187 | 726 | 3,203 | (12) | (116) | 30.9 | 4.0 | 5.7 |
| F2 AST plus Sand Filter | 377 | 296 | 14 | 152 | 924 | 3,284 | (12) | (82) | 42.6 | 6.3 | 8.3 |
| F3 AST plus chemically assisted coagulation | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 57.3 | 6.8 | 10.2 |
| F4 AST with granular filtration | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 53.2 | 7.8 | 10.4 |

FINE PAPER/DEINKING/TISSUE/BOARD SUBSECTOR – December 11/91

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZED |
| **KIMBERLY–CLARK (St. Catherines)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 22 | 118 | 0 | 7 | 22 | 118 | 0 | 7 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 22 | 118 | 0 | 7 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| F2 AST plus Sand Filter | 22 | 118 | 0 | 7 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| F3 AST plus chemically assisted coagulation | 22 | 118 | 0 | N/A | 0 | 0 | 0 | N/A | 0.0 | 0.0 | 0.0 |
| F4 AST with granular filtration | 22 | 118 | 0 | N/A | 0 | 0 | 0 | N/A | 0.0 | 0.0 | 0.0 |
| TOTALS for Fine Paper Subsector | | | | | | | | | | | |
| Initial Loadings | 1,300 | 3,581 | 3 | 70 | 1,300 | 3,581 | 3 | 70 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 575 | 378 | 15 | 187 | 726 | 3,203 | (12) | (116) | 30.9 | 4.0 | 5.7 |
| F2 AST plus Sand Filter | 377 | 296 | 14 | 152 | 924 | 3,284 | (12) | (82) | 42.6 | 6.3 | 8.3 |
| F3 AST plus chemically assisted coagulation | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 57.3 | 6.8 | 10.2 |
| F4 AST with granular filtration | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 53.2 | 7.8 | 10.4 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZED |
| **KIMBERLY–CLARK (Huntsville)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 2 | 1 | 0 | 2 | 2 | 1 | 0 | 2 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 2 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| F2 AST plus Sand Filter | 2 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 |
| F3 AST plus chemically assisted coagulation | 2 | 1 | 0 | N/A | 0 | 0 | 0 | N/A | 0.0 | 0.0 | 0.0 |
| F4 AST with granular filtration | 2 | 1 | 0 | N/A | 0 | 0 | 0 | N/A | 0.0 | 0.0 | 0.0 |
| TOTALS for Fine Paper Subsector | | | | | | | | | | | |
| Initial Loadings | 1,300 | 3,581 | 3 | 70 | 1,300 | 3,581 | 3 | 70 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 575 | 378 | 15 | 187 | 726 | 3,203 | (12) | (116) | 30.9 | 4.0 | 5.7 |
| F2 AST plus Sand Filter | 377 | 296 | 14 | 152 | 924 | 3,284 | (12) | (82) | 42.6 | 6.3 | 8.3 |
| F3 AST plus chemically assisted coagulation | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 57.3 | 6.8 | 10.2 |
| F4 AST with granular filtration | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 53.2 | 7.8 | 10.4 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZED |
| PAPERBOARD (Trent Valley) | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 188 | 554 | 0 | 5 | 188 | 554 | 0 | 5 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 70 | 31 | 1 | 14 | 118 | 522 | (1) | (9) | 3.1 | 0.3 | 0.5 |
| F2 AST plus Sand Filter | 31 | 16 | 1 | 16 | 156 | 538 | (0) | (11) | 6.6 | 1.0 | 1.3 |
| F3 AST plus chemically assisted coagulation | 16 | 11 | 1 | N/A | 171 | 543 | (0) | N/A | 8.2 | 1.1 | 1.5 |
| F4 AST with granular filtration | 16 | 11 | 1 | N/A | 171 | 543 | (0) | N/A | 7.8 | 1.1 | 1.5 |
| TOTALS for Fine Paper Subsector | | | | | | | | | | | |
| Initial Loadings | 1,300 | 3,581 | 3 | 70 | 1,300 | 3,581 | 3 | 70 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 575 | 378 | 15 | 187 | 726 | 3,203 | (12) | (116) | 30.9 | 4.0 | 5.7 |
| F2 AST plus Sand Filter | 377 | 296 | 14 | 152 | 924 | 3,284 | (12) | (82) | 42.6 | 6.3 | 8.3 |
| F3 AST plus chemically assisted coagulation | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 57.3 | 6.8 | 10.2 |
| F4 AST with granular filtration | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 53.2 | 7.8 | 10.4 |

| SOURCE TREATMENT PLANS | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZED |
| STRATHCONA (Napanee) | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 89 | 222 | 1 | 14 | 89 | 222 | 1 | 14 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 74 | 33 | 1 | 15 | 15 | 188 | 0 | (1) | 0.5 | 0.1 | 0.1 |
| F2 AST plus Sand Filter | 17 | 8 | 1 | 8 | 71 | 214 | (0) | 6 | 4.7 | 1.0 | 1.1 |
| F3 AST plus chemically assisted coagulation | 8 | 6 | 0 | N/A | 81 | 216 | 0 | N/A | 5.7 | 1.0 | 1.2 |
| F4 AST with granular filtration | 8 | 6 | 0 | N/A | 81 | 216 | 0 | N/A | 5.5 | 1.0 | 1.2 |
| TOTALS for Fine Paper Subsector | | | | | | | | | | | |
| Initial Loadings | 1,300 | 3,581 | 3 | 70 | 1,300 | 3,581 | 3 | 70 | | | |
| Options | | | | | | | | | | | |
| F1 Exemplary activated Sludge | 575 | 378 | 15 | 187 | 726 | 3,203 | (12) | (116) | 30.9 | 4.0 | 5.7 |
| F2 AST plus Sand Filter | 377 | 296 | 14 | 152 | 924 | 3,284 | (12) | (82) | 42.6 | 6.3 | 8.3 |
| F3 AST plus chemically assisted coagulation | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 57.3 | 6.8 | 10.2 |
| F4 AST with granular filtration | 200 | 244 | 9 | N/A | 1,101 | 3,337 | (6) | N/A | 53.2 | 7.8 | 10.4 |

| | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SOURCE TREATMENT PLANS | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZED |
| **DOMTAR (Trenton)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 210 | 1,919 | 1 | 9 | 210 | 1,919 | 1 | 9 | | | |
| Options | | | | | | | | | | | |
| C1 Exemplary activated Sludge | 32 | 16 | 2 | 16 | 178 | 1,903 | (1) | (7) | 10.5 | 2.1 | 2.3 |
| C2 AST plus Sand Filter | 16 | 11 | 1 | N/A | 193 | 1,908 | 0 | N/A | 12.1 | 2.1 | 2.5 |
| C3 AST plus chemically assisted coagulation | 16 | 11 | 1 | N/A | 193 | 1,908 | 0 | N/A | 11.7 | 2.2 | 2.6 |
| TOTALS for the Sulphite Subsector | | | | | | | | | | | |
| Initial Loadings | 1,171 | 15,383 | 11 | 128 | 1,171 | 15,383 | 11 | 128 | | | |
| Options | | | | | | | | | | | |
| C1 Exemplary activated Sludge | 132 | 66 | 6 | 66 | 1,039 | 15,317 | 6 | 62 | 27.3 | 4.7 | 5.7 |
| C2 AST plus Sand Filter | 66 | 46 | 3 | 0 | 1,104 | 15,337 | 8 | 120 | 32.7 | 4.9 | 6.4 |
| C3 AST plus chemically assisted coagulation | 66 | 46 | 3 | 0 | 1,104 | 15,337 | 8 | 120 | 31.2 | 5.3 | 6.5 |

| | FINAL LOADINGS | | | | LOADING REDUCTIONS | | | | COSTS | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SOURCE TREATMENT PLANS | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | TSS | BOD | Phosphorus | Kjeldahl Nitrogen | CAPITAL | O&M | ANNUALIZED |
| **MACMILLAN (Sturgeon Falls)** | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | tonnes/year | $millions | $m/year | $m/year |
| Initial Loadings | 961 | 13,463 | 10 | 120 | 961 | 13,463 | 10 | 120 | | | |
| Options | | | | | | | | | | | |
| C1 Exemplary activated Sludge | 100 | 50 | 4 | 50 | 861 | 13,413 | 6 | 70 | 16.9 | 2.6 | 3.4 |
| C2 AST plus Sand Filter | 50 | 35 | 2 | N/A | 911 | 13,429 | 8 | 120 | 20.6 | 2.8 | 3.8 |
| C3 AST plus chemically assisted coagulation | 50 | 35 | 2 | N/A | 911 | 13,429 | 8 | 120 | 19.5 | 3.1 | 3.9 |
| TOTALS for the Sulphite Subsector | | | | | | | | | | | |
| Initial Loadings | 1,171 | 15,383 | 11 | 128 | 1,171 | 15,383 | 11 | 128 | | | |
| Options | | | | | | | | | | | |
| C1 Exemplary activated Sludge | 132 | 66 | 6 | 66 | 1,039 | 15,317 | 6 | 62 | 27.3 | 4.7 | 5.7 |
| C2 AST plus Sand Filter | 66 | 46 | 3 | 0 | 1,104 | 15,337 | 8 | 120 | 32.7 | 4.9 | 6.4 |
| C3 AST plus chemically assisted coagulation | 66 | 46 | 3 | 0 | 1,104 | 15,337 | 8 | 120 | 31.2 | 5.3 | 6.5 |

# APPENDIX B

## DEFINITION AND CALCULATION OF STANDARD RATIOS

## PROCEDURE FOR ADJUSTING FINANCIAL DATA

## DEFINITION AND CALCULATION OF FINANCIAL INDICATORS

## I. CORPORATE/FIRM/SECTOR LEVEL INDICATORS

### Liquidity Indicators

| | |
|---|---|
| Quick Ratio (x:1 ) | (Current assets [less inventories] / Current liabilities)<br><br>Quick ratio indicates the level of protection provided to short term creditors. It shows the number of dollars of liquid assets (i.e., assets that are easily convertible to cash such as marketable securities, term deposits) available to cover each dollar of current debt. A quick ratio of 1:1 or greater indicates that the business is in a liquid position. |
| Note: | Current assets include cash and other assets that will either be transformed into cash or will be sold or consumed within one year or within the normal operating cycle of the business, if longer than one year. |
| Current Ratio (x:1) | (Current assets / Current liabilities)<br><br>Current ratio indicates the degree to which a company has sufficient current assets to cover current liabilities. The higher the ratio the greater the assurance that current liabilities can be met. A current ratio of 2:1 or better is generally considered desirable. |
| Net Working Capital to Total Assets (%) | {(Current assets - Current liabilities) / Total assets} x 100<br><br>Net working capital to total assets ratio indicates the proportion of total company assets which are currently available to cover unexpected expenses. |

### Solvency Indicators

| | |
|---|---|
| Total Debt to Total Assets (%) | (Total debt / Total assets) x 100<br><br>Total debt to total assets measures the degree to which a company is leveraged (i.e., financed by outside debt). A higher total debt/total assets ratio indicates that the company is highly |

leveraged which may limit their ability to raise additional capital (at a reasonable interest rate) to finance large capital expenditures.

| | |
|---|---|
| Interest Coverage (Times) | (Net income before interest, extra-ordinary items and all taxes) / Annual interest charges.<br><br>Interest coverage provides information on the extent to which a company's normal operating income is sufficient to cover annual interest charges. A company with a low interest coverage ratio may be unable to pay its annual interest charges and would therefore have a higher risk of being forced into insolvency by creditors. |
| Cash Flow ($) | Net income before extraordinary items and all non-cash expenses (e.g., depreciation, amortization, deferred taxes)<br><br>Cash flow provides a measure of a company's ability to pay dividends and finance expansion. A company which shows little net after-tax profit may still be able to meet its short term debts and obligations if cash flow is adequate. |
| Cash Flow to Total Debt (Beaver's Ratio) (%) | {(Net income before extraordinary items, depreciation and deferred taxes) / Total debt} x 100<br><br>Cash flow to total debt indicates the percentage of total debt which is covered by current cash flow. This should be considered in relation to the number of years the debt is being amortized. |

<u>Profitability Indicators</u>

| | |
|---|---|
| Return on Assets (%) | {Net income (before interest and extraordinary items but after taxes)}/Total assets x 100<br><br>Return on assets is a key indicator of a company's profitability. It matches net after-tax profits (from normal operations) with the assets available to earn a return. Companies that are using their assets efficiently will have a relatively high rate of return. Excluding interest from the definition of normal operating income eliminates any bias resulting from a company's decision to finance assets through long term debt versus raising additional capital internally (i.e, through issuing shares). |

| | |
|---|---|
| Return on Net Assets (RONA) (%) | {Net income (before interest and extraordinary items but after taxes) / (Total assets - Total liabilities)} x 100<br><br>Similar to return on assets except the return is expressed as a percentage of net assets. |
| Earnings Before Interest but After Taxes to Total Assets (EBIAT/TA) (%) | (Net income before interest but after taxes / Total assets) x 100<br><br>Similar to return on assets (above) except the definition of net income includes extraordinary items. |
| Earnings Before Interest and Taxes to Total Assets (EBIT/TA) (%) | (Net income before interest and all taxes / Total assets) x 100<br><br>Similar to return on assets (above) except the net income is before taxes and includes extraordinary items. |
| Return on Sales (Profit Margin) (%) | {Net income (after taxes)/ Sales} x 100<br><br>Return on sales measures the profits earned per dollar of sales indicating the profitability of the company. It also indicates the company's ability to survive adverse conditions such as falling prices, rising costs and declining sales. |
| Return on Capital current % | {Net income (after taxes) plus after tax interest charges and extraordinary items / Total assets Employed less liabilities} x 100<br><br>This measures the rate of return being earned on company assets employed in operations. It provides an indication of the level of incentive for owners and investors to remain in that particular enterprise. |
| Net Income ($) | Total revenue less all expenses (cost of sales, (Profit) operating expenses, taxes) |

Efficiency Indicators

| | |
|---|---|
| Total Assets Sales (%) | (Total Assets/Sales) x 100<br><br>Total assets to sales indicates the level of investment that is required to generate those sales. A high percentage (in comparison to industry averages) may indicate that the company is not using assets efficiently or needs to market its product more aggressively. |

Other Indicators

| | |
|---|---|
| Amortized and Total Recorded Regulatory Capital Costs as a Percent Recorded Capital Expenditures (%) | (Amortized or Total Regulatory Capital Cost / Total Capital Expenditures) x 100<br><br>This ratio indicates the extent to which capital requirements implied by regulatory requirements would divert available capital resources from other uses. |
| Regulatory Operating Expenses as a Percent of Recorded Operating Expenditures (%) | (Regulatory-induced Annual Operating Expenses / Recorded operating and maintenance expenses) x 100<br><br>This ratio indicates the extent to which operating and maintenance expenses would increase due regulatory-induced operating costs. |

## II. DIVISION/PLANT LEVEL INDICATORS

Profitability Indicators

| | |
|---|---|
| Operating profits | Total revenue less operating expenses ($) (includes cost of sales) |
| Return on Assets (%) | (Operating profits / Assets) x 100 |

| | |
|---|---|
| | Key indicator to assess divisional profitability. It also provides a rough assessment of the return on investment at the level of the division. |
| Return on Sales (%) | (Operating profits / Sales) x 100<br><br>Assesses a division's capacity to withstand unfavourable market conditions such as falling product prices, rising input costs or depressed sales volumes. |
| Return per Unit of production ($/unit) | Operating profits / Sales volume or units<br><br>This ratio measures the contribution of each unit of sale to profits. In conjunction with the expenses index, it provides a composite assessment of a division's efficiency in converting raw materials to consumable products. |
| <u>Efficiency</u> | |
| Expenses to Sales (%) | (Expenses / Sales) x 100<br><br>This ratio shows the proportion of sales revenue that goes towards the recovery of production costs. The lower this ratio the higher the division's profits. |
| Cost per Unit ($/unit) | Expenses / Sales volume (quantity)<br><br>Indicates the unit cost of manufacturing the product. |

# PROCEDURE FOR ADJUSTING FINANCIAL DATA

**Debt Financing Option**

| Key Figures Impacted | | Amounts for Impact |
|---|---|---|
| **Balance Sheet** | | |
| -Fixed Assets | **Add:** | Capital cost of abatement (& monitoring) less 1st year depreciation. |
| -Other Current Assets | **Deduct:** | Current years payment on long-term debt (LTD) |
| -Current portion | **Add:** | Current portion of LTD, of LT Debt principal payable within the next year.* |
| -Long term Debt | **Add:** | Year end balance of LTD related to abatement costs (Initial capital cost less 1st year (amortized) payment and current portion for following year).* |
| -Share Capital | **Add:** | N/A |
| -Retained Earnings | **Add:** | After abatement net income (less pre-abatement net income) |
| **Income Statement** | | |
| -Depreciation | **Add:** | 1 year of depreciation of capital costs. |
| -Interest | **Add:** | 1st year interest on LTD.* |
| -Operating Expenses | **Add:** | Annual O&M (monitoring and abatement) costs. |
| -Current income taxes | **Deduct:** | Tax impact of higher interest, O&M and capital costs* (use capital cost allowance (CCA) rate of 25 or 35.9%). |
| -Net Income | | Previous net income adjusted for impact of above changes. |
| Other | | |
| -Capital exp. | **Add:** | Capital exp. for abatement and monitoring |

* Appropriate amounts can be determined from completing the 1st two years of a loan amortization schedule.

** Interest expense determined as an internal cost of capital

# APPENDIX C

# ECONOMIC IMPACT TABLES

## LIST OF TABLES

# TABLE C-1

FINANCIAL INDICATORS: BEFORE ABATEMENT

| Firm | Year | Return on Assets (%) ROA | Return on Sales (%) ROS | Earning before Interest but After Taxes (%) EBIAT | Earnings before Interest and Taxes (%) EBIT | Return on Capital (%) ROC | Net Income ('000's $) NI | Return On Net Assets (%) RONA | Cash Flow to Debt (%) CF/TD | Total Debt to Total Assets (%) TD/TA | Interest Coverage (Ratio) IC | Current Ratio CR | Quick Ratio QR | Working Capital To Assets (%) WC/TA | Net Internal Cash Flow ('000's $) NICF | Total Assets to Sales (%) TA/S | Operating Income ('000's $) OI | Capital Expenditures ('000's $) CE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ABITIBI-PRICE (4 MILLS) | | | | | | | | | | | | | | | | | | |
| | 1981 | 9.5 | 6.8 | 9.2 | 14.8 | 10.3 | 119,641 | 19.3 | 24.8 | 55.2 | 7.9 | 2.8 | 1.6 | 26.2 | 224,102 | 92.8 | 192,955 | 202,800 |
| | 1982 | 5.8 | 3.6 | 5.6 | 7.2 | 5.8 | 58,358 | 9.5 | 17.7 | 49.1 | 3.8 | 3.0 | 1.7 | 27.0 | 140,577 | 99.1 | 52,481 | 181,600 |
| | 1983 | 3.4 | 2.1 | 3.4 | 3.7 | 3.2 | 35,021 | 4.9 | 13.1 | 49.3 | 3.1 | 2.7 | 1.4 | 22.6 | 107,320 | 102.4 | 13,977 | 155,200 |
| | 1984 | 6.4 | 3.4 | 6.1 | 8.3 | 6.2 | 73,130 | 10.0 | 18.2 | 50.1 | 3.7 | 2.6 | 1.3 | 22.5 | 169,039 | 85.2 | 94,846 | 103,600 |
| | 1985 | 7.1 | 3.9 | 7.1 | 10.8 | 7.5 | 100,200 | 11.9 | 18.9 | 52.7 | 4.6 | 2.0 | 1.1 | 18.0 | 207,100 | 81.4 | 159,300 | 193,900 |
| | 1986 | 6.6 | 3.9 | 6.5 | 11.0 | 6.9 | 107,300 | 11.1 | 22.1 | 47.7 | 6.7 | 2.4 | 1.3 | 20.5 | 236,200 | 81.0 | 205,900 | 249,300 |
| | 1987 | 6.6 | 4.2 | 6.6 | 11.1 | 7.0 | 125,700 | 12.6 | 20.1 | 52.6 | 6.7 | 2.6 | 1.6 | 24.4 | 269,400 | 85.3 | 223,400 | 220,300 |
| | 1988 | 9.1 | 5.8 | 9.2 | 13.1 | 9.6 | 191,100 | 16.0 | 22.5 | 49.3 | 6.8 | 2.6 | 1.4 | 21.1 | 292,600 | 79.6 | 276,300 | 168,200 |
| | 1989 | 3.9 | 1.7 | 3.9 | 5.5 | 3.9 | 54,200 | 6.2 | 12.5 | 51.6 | 3.1 | 1.6 | 0.8 | 12.1 | 165,700 | 78.4 | 111,000 | 212,700 |
| | 1990 | (0.5) | (1.4) | (0.5) | (0.2) | (0.6) | (44,600) | (0.8) | 5.2 | 53.7 | (0.1) | 1.4 | 0.6 | 7.6 | 68,700 | 80.2 | (19,300) | 106,700 |
| | 10 yr. Avg. | 5.6 | 3.4 | 5.7 | 8.5 | 6.0 | 82,005.0 | 10.1 | 17.5 | 51.1 | 4.6 | 2.4 | 1.3 | 20.4 | 188,073.8 | 86.6 | 131,085.9 | 179,430.0 |
| BOISE CASCADE (2 MILLS) | | | | | | | | | | | | | | | | | | |
| | 1981 | 7.4 | 3.9 | 7.4 | 9.7 | 7.3 | 144,000 | 9.5 | 18.2 | 51.0 | 3.3 | 1.8 | 0.8 | 12.3 | 304,800 | 88.2 | 140,400 | 284,400 |
| | 1982 | 3.4 | 0.2 | 3.0 | 3.0 | 2.1 | 6,638 | 3.3 | 10.1 | 51.1 | 1.0 | 1.7 | 0.8 | 11.5 | 170,292 | 91.4 | (48,126) | 186,334 |
| | 1983 | 4.6 | 1.7 | 4.6 | 5.6 | 4.5 | 87,494 | 6.8 | 14.7 | 50.7 | 2.2 | 1.6 | 0.9 | 12.8 | 261,184 | 82.2 | 107,184 | 197,120 |
| | 1984 | 4.4 | 1.6 | 4.4 | 4.8 | 4.3 | 90,650 | 6.0 | 10.9 | 58.4 | 2.1 | 1.4 | 0.7 | 8.2 | 281,015 | 89.3 | 73,615 | 843,045 |
| | 1985 | 6.7 | 2.6 | 6.7 | 8.3 | 6.3 | 141,960 | 8.3 | 15.4 | 55.6 | 2.4 | 1.4 | 0.8 | 7.5 | 382,200 | 87.4 | 126,310 | 477,750 |
| | 1986 | 6.1 | 2.7 | 6.1 | 8.1 | 5.7 | 141,678 | 7.5 | 16.7 | 55.4 | 2.5 | 1.6 | 0.9 | 6.9 | 455,592 | 94.5 | 237,519 | 612,549 |
| | 1987 | 8.5 | 4.8 | 8.5 | 12.5 | 8.7 | 242,658 | 12.0 | 23.6 | 53.8 | 4.0 | 1.5 | 0.8 | 7.8 | 567,528 | 88.3 | 409,734 | 343,434 |
| | 1988 | 10.8 | 7.1 | 10.8 | 16.0 | 11.9 | 355,759 | 16.4 | 27.1 | 53.5 | 5.7 | 1.3 | 0.7 | 5.2 | 645,044 | 86.2 | 577,339 | 556,412 |
| | 1989 | 8.8 | 6.2 | 8.8 | 12.9 | 9.4 | 316,815 | 14.1 | 19.7 | 62.0 | 5.6 | 1.4 | 0.7 | 6.1 | 598,709 | 95.5 | 492,116 | 855,796 |
| | 1990 | 4.0 | 1.8 | 4.0 | 5.0 | 3.6 | 78,135 | 5.0 | 10.7 | 67.1 | 2.0 | 1.3 | 0.7 | 5.0 | 399,621 | 114.3 | 136,441 | 961,558 |
| | 10 yr. Avg. | 6.5 | 3.3 | 6.4 | 8.6 | 6.4 | 160,778.7 | 8.9 | 16.7 | 55.9 | 3.1 | 1.5 | 0.8 | 8.5 | 406,618.5 | 91.9 | 225,673.4 | 531,639.8 |
| CP FOREST PRODUCTS (2 MILLS) | | | | | | | | | | | | | | | | | | |
| | 1981 | 14.7 | 13.7 | 14.7 | 23.6 | 15.9 | 77,774 | 24.6 | 52.9 | 44.2 | 17.0 | 2.2 | 1.1 | 13.3 | 137,095 | 103.1 | 121,173 | 189,023 |
| | 1982 | 3.5 | 4.2 | 3.5 | 3.4 | 3.6 | 18,552 | 4.9 | 18.3 | 54.0 | 3.7 | 1.5 | 0.7 | 6.6 | 71,622 | 165.4 | 16,872 | 166,765 |
| | 1983 | 1.1 | (1.9) | 1.1 | (0.4) | 0.2 | (9,390) | 0.3 | 4.2 | 56.3 | (0.2) | 1.2 | 0.6 | 3.7 | 16,962 | 146.5 | (22,113) | 56,023 |
| | 1984 | 5.6 | 3.0 | 5.6 | 7.0 | 4.9 | 17,779 | 6.7 | 16.1 | 57.2 | 2.2 | 1.7 | 0.8 | 9.7 | 70,722 | 127.6 | 27,503 | 47,223 |
| | 1985 | 3.7 | 0.0 | 3.3 | 3.7 | 2.8 | 216 | 3.7 | 8.9 | 56.3 | 1.3 | 1.6 | 0.7 | 6.6 | 39,619 | 129.7 | 7,248 | 45,108 |
| | 1986 | 7.0 | 4.7 | 7.0 | 7.7 | 6.1 | 30,049 | 15.7 | 22.6 | 55.6 | 2.5 | 1.6 | 0.9 | 11.6 | 97,907 | 120.8 | 59,679 | 30,749 |
| | 1987 | 13.3 | 12.8 | 13.3 | 22.7 | 15.5 | 96,185 | 27.1 | 33.3 | 50.8 | 12.8 | 2.1 | 1.4 | 15.6 | 141,049 | 110.8 | 176,418 | 52,434 |
| | 1988 | 13.1 | 11.6 | 13.1 | 21.4 | 16.1 | 323,400 | 24.5 | 39.9 | 42.9 | 14.7 | 1.3 | 0.7 | 7.1 | 474,100 | 99.8 | 546,900 | 237,200 |
| | 1989 | 7.9 | 8.3 | 7.9 | 12.6 | 9.2 | 220,100 | 13.6 | 26.2 | 44.6 | 16.6 | 1.5 | 0.7 | 8.4 | 360,500 | 115.8 | 353,700 | 409,900 |
| | 1990 | 1.0 | (0.4) | 1.0 | 1.2 | 0.6 | (9,400) | 0.8 | 8.1 | 49.8 | 0.9 | 1.6 | 0.7 | 9.6 | 131,600 | 152.9 | (28,200) | 470,900 |
| | 10 yr. Avg. | 7.1 | 5.6 | 7.1 | 10.3 | 7.7 | 76,526.5 | 12.2 | 23.0 | 51.4 | 7.1 | 1.7 | 0.8 | 9.5 | 154,137.6 | 127.3 | 125,918.0 | 170,732.5 |

# TABLE C-1

FINANCIAL INDICATORS: BEFORE ABATEMENT

| Firm | Year | Return on Assets (%) ROA | Return on Sales (%) ROS | Earning before Interest but After Taxes (%) EBIAT | Earnings before Interest and Taxes (%) EBIT | Return on Capital (%) ROC | Net Income ('000's $) NI | Return On Net Assets (%) RONA | Cash Flow to Debt (%) CF/TD | Total Debt to Total Assets (%) TD/TA | Interest Coverage (Ratio) IC | Current Ratio CR | Quick Ratio QR | Working Capital To Assets (%) WC/TA | Net Internal Cash Flow ('000's $) NICF | Total Assets to Sales (%) TA/S | Operating Income ('000's $) OI | Capital Expenditures ('000's $) CE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DOMTAR INC (4 MILLS) | | | | | | | | | | | | | | | | | | |
| | 1981 | 5.9 | 3.6 | 6.3 | 7.9 | 6.5 | 63,556 | 12.4 | 21.4 | 51.3 | 5.5 | 2.7 | 1.5 | 27.9 | 143,162 | 73.8 | 67,835 | 164,323 |
| | 1982 | 2.5 | (0.1) | 1.7 | 1.4 | 2.1 | (1,600) | 3.6 | 10.8 | 53.7 | 1.3 | 2.7 | 1.5 | 23.9 | 76,500 | 78.1 | (2,200) | 168,800 |
| | 1983 | 5.2 | 2.2 | 5.2 | 6.2 | 5.2 | 40,200 | 9.3 | 16.4 | 53.3 | 2.8 | 2.6 | 1.6 | 24.1 | 118,100 | 74.2 | 53,400 | 107,700 |
| | 1984 | 8.0 | 4.6 | 8.3 | 10.9 | 8.5 | 93,900 | 16.0 | 24.9 | 49.9 | 4.9 | 2.8 | 1.7 | 26.5 | 188,800 | 74.4 | 109,500 | 132,900 |
| | 1985 | 7.0 | 5.2 | 7.6 | 10.9 | 7.9 | 110,400 | 14.8 | 22.0 | 51.5 | 6.1 | 2.0 | 1.3 | 19.6 | 204,400 | 84.5 | 132,900 | 284,400 |
| | 1986 | 6.7 | 6.2 | 7.0 | 11.3 | 7.9 | 145,000 | 14.4 | 25.8 | 50.4 | 16.6 | 1.9 | 1.3 | 16.7 | 295,600 | 97.6 | 221,400 | 457,100 |
| | 1987 | 6.0 | 6.3 | 6.0 | 9.7 | 6.8 | 161,000 | 10.6 | 20.8 | 57.1 | 25.1 | 1.9 | 1.1 | 12.2 | 340,000 | 111.2 | 277,000 | 511,000 |
| | 1988 | 4.6 | 4.1 | 4.6 | 6.6 | 4.9 | 111,000 | 7.3 | 16.0 | 59.9 | 6.2 | 1.5 | 0.8 | 7.7 | 305,000 | 117.9 | 179,000 | 407,000 |
| | 1989 | 3.3 | 1.3 | 3.3 | 3.4 | 3.0 | 33,000 | 4.2 | 9.1 | 61.7 | 1.5 | 1.3 | 0.7 | 5.7 | 185,000 | 130.4 | 14,000 | 322,000 |
| | 1990 | (7.0) | (12.7) | (7.0) | (12.0) | (9.9) | (294,000) | (13.9) | (13.6) | 67.3 | (3.5) | 1.4 | 0.6 | 6.1 | (259,000) | 122.0 | (476,000) | 200,000 |
| | 10 yr. Avg. | 4.2 | 2.1 | 4.3 | 5.6 | 4.3 | 46,245.6 | 7.9 | 15.4 | 55.6 | 6.7 | 2.1 | 1.2 | 17.0 | 159,756.2 | 96.4 | 57,683.5 | 275,522.3 |
| MACMILLAN (1 MILL) | | | | | | | | | | | | | | | | | | |
| | 1981 | 1.7 | 0.1 | 3.1 | 1.8 | 0.6 | 3,307 | 0.8 | 2.2 | 35.6 | 0.1 | 1.8 | 0.7 | 14.4 | 26,329 | 98.3 | (70,429) | 307,856 |
| | 1982 | (0.7) | (3.1) | 1.0 | (0.4) | (2.7) | (57,300) | (3.3) | (8.4) | 57.7 | (0.6) | 1.5 | 0.7 | 9.8 | (104,600) | 116.7 | (145,100) | 206,800 |
| | 1983 | 3.8 | 1.2 | 4.8 | 3.9 | 3.2 | 23,900 | 3.5 | 7.2 | 54.1 | 0.8 | 1.4 | 0.6 | 9.2 | 82,900 | 103.7 | (40,300) | 103,600 |
| | 1984 | 4.9 | 1.0 | 4.9 | 4.0 | 4.2 | 19,300 | 4.6 | 8.3 | 56.2 | 1.0 | 1.6 | 0.7 | 12.3 | 105,500 | 106.1 | (21,700) | 137,700 |
| | 1985 | 5.8 | 1.8 | 5.6 | 6.2 | 4.9 | 42,700 | 5.8 | 13.8 | 31.7 | 1.6 | 2.2 | 1.0 | 17.4 | 166,100 | 99.8 | 16,900 | 96,600 |
| | 1986 | 9.1 | 7.1 | 11.2 | 14.2 | 9.3 | 178,300 | 11.0 | 31.1 | 39.9 | 4.0 | 2.1 | 0.9 | 16.3 | 272,700 | 87.4 | 155,200 | 100,000 |
| | 1987 | 13.2 | 9.0 | 13.2 | 20.5 | 14.3 | 280,600 | 22.4 | 47.8 | 45.3 | 10.2 | 2.6 | 1.3 | 21.3 | 544,500 | 80.3 | 415,100 | 256,600 |
| | 1988 | 13.6 | 10.1 | 13.6 | 19.4 | 15.5 | 329,800 | 23.2 | 38.6 | 45.4 | 12.3 | 2.1 | 1.0 | 17.4 | 482,500 | 84.1 | 435,400 | 364,000 |
| | 1989 | 9.2 | 7.5 | 9.2 | 12.9 | 10.1 | 246,700 | 13.2 | 25.0 | 60.1 | 7.9 | 2.0 | 0.9 | 14.7 | 410,200 | 100.0 | 311,500 | 518,400 |
| | 1990 | 3.6 | 1.6 | 3.6 | 3.4 | 3.1 | 50,800 | 4.1 | 9.9 | 55.3 | 1.5 | 2.1 | 1.0 | 14.6 | 197,100 | 119.0 | 10,300 | 366,500 |
| | 10 yr. Avg. | 6.4 | 3.6 | 7.0 | 8.6 | 6.3 | 111,810.7 | 8.5 | 17.5 | 51.1 | 3.9 | 1.9 | 0.9 | 14.7 | 218,322.9 | 99.5 | 106,687.1 | 245,805.6 |
| NORANDA (1 MILL) | | | | | | | | | | | | | | | | | | |
| | 1981 | 7.8 | 3.8 | 7.8 | 9.3 | 7.1 | 16,184 | 9.2 | 16.1 | 59.5 | 2.2 | 1.9 | 0.6 | 11.8 | 42,477 | 105.2 | 14,733 | 71,989 |
| | 1982 | 2.5 | (1.2) | 2.5 | 1.6 | 1.3 | (4,761) | 1.5 | 3.7 | 65.4 | 0.5 | 1.7 | 0.8 | 8.2 | 12,611 | 132.7 | (7,734) | 114,157 |
| | 1983 | 4.0 | 2.5 | 4.0 | 4.6 | 3.3 | 10,755 | 4.0 | 9.2 | 66.7 | 2.2 | 1.9 | 0.9 | 8.3 | 38,433 | 142.8 | 14,843 | 94,986 |
| | 1984 | 5.3 | 0.7 | 5.3 | 5.6 | 3.9 | 3,487 | 4.6 | 7.3 | 68.2 | 1.2 | 1.7 | 0.6 | 8.0 | 32,421 | 123.5 | 5,814 | 39,368 |
| | 1985 | 2.3 | 3.4 | 7.8 | 5.3 | 0.0 | 11,931 | 0.0 | 1.7 | 66.5 | (0.0) | 0.9 | 0.4 | (1.6) | 6,375 | 159.9 | (41,353) | 22,325 |
| | 1986 | 6.1 | 2.9 | 6.7 | 10.9 | 5.3 | 103,000 | 8.9 | 9.3 | 79.1 | 2.7 | 1.9 | 0.9 | 13.0 | 246,000 | 99.5 | 192,000 | 146,300 |
| | 1987 | 7.8 | 4.5 | 7.8 | 17.1 | 7.6 | 203,000 | 15.3 | 14.3 | 69.9 | 5.8 | 2.4 | 1.2 | 17.2 | 412,000 | 92.3 | 538,000 | 335,000 |
| | 1988 | 8.2 | 5.6 | 8.2 | 17.0 | 8.5 | 263,000 | 16.7 | 15.0 | 69.0 | 7.3 | 2.0 | 1.0 | 15.0 | 468,000 | 95.6 | 614,000 | 560,000 |
| | 1989 | 6.0 | 3.9 | 6.0 | 11.3 | 5.9 | 189,000 | 9.9 | 10.2 | 73.4 | 4.4 | 1.7 | 0.6 | 11.3 | 415,000 | 114.5 | 430,000 | 810,000 |
| | 1990 | 2.4 | (2.1) | 2.4 | 1.5 | 1.0 | (95,000) | 1.4 | 3.8 | 77.5 | 0.4 | 1.3 | 0.6 | 6.2 | 174,000 | 130.8 | (159,000) | 569,000 |
| | 10 yr. Avg. | 5.2 | 2.4 | 5.9 | 8.4 | 4.4 | 70,059.6 | 7.1 | 9.1 | 69.5 | 2.7 | 1.7 | 0.8 | 9.7 | 184,731.7 | 119.7 | 160,130.3 | 276,310.5 |
| PAPER AND ALLIED GROUP (CANADA) | | | | | | | | | | | | | | | | | | |
| | 1981 | 7.5 | 5.2 | 7.9 | 10.7 | 7.6 | 873,000 | 10.2 | 15.9 | 57.1 | 3.2 | 1.9 | 0.9 | 16.0 | 1,691,000 | 110.6 | 1,049,000 | 2,388,000 |
| | 1982 | 4.0 | −0.6 | 3.8 | 3.6 | 2.7 | (90,000) | 3.5 | 5.3 | 57.6 | 0.9 | 1.9 | 0.9 | 14.0 | 595,000 | 128.0 | (363,000) | 1,829,000 |
| | 1983 | 3.8 | 0.0 | 3.8 | 3.5 | 2.9 | 0 | 3.6 | 5.6 | 59.6 | 0.9 | 1.6 | 0.8 | 11.4 | 703,000 | 123.1 | (280,000) | 1,170,000 |
| | 1984 | 6.4 | 3.3 | 6.9 | 7.8 | 5.9 | 614,000 | 7.6 | 12.3 | 55.5 | 1.9 | 1.7 | 0.9 | 13.1 | 1,459,000 | 113.1 | 509,000 | 1,299,000 |
| | 1985 | 6.1 | 2.2 | 5.3 | 6.6 | 5.9 | 436,000 | 8.2 | 12.3 | 57.0 | 2.1 | 1.6 | 0.9 | 12.3 | 1,639,000 | 119.0 | 536,000 | 1,709,000 |
| | 1986 | 7.9 | 5.1 | 7.6 | 10.5 | 8.1 | 1,092,000 | 11.5 | 19.6 | 53.6 | 3.5 | 1.8 | 1.1 | 14.0 | 2,595,000 | 114.6 | 1,544,000 | 1,976,000 |
| | 1987 | 10.7 | 9.8 | 11.3 | 16.7 | 11.8 | 2,515,000 | 16.3 | 26.6 | 54.7 | 7.0 | 1.9 | 1.2 | 15.3 | 4,412,000 | 109.2 | 3,378,000 | 2,304,000 |
| | 1988 | 10.1 | 9.4 | 10.5 | 15.3 | 11.0 | 2,743,000 | 16.0 | 24.8 | 56.8 | 7.2 | 1.9 | 1.1 | 13.6 | 4,573,000 | 111.9 | 3,915,000 | 2,921,000 |
| | 1989 | 7.6 | 6.8 | 7.7 | 11.0 | 7.9 | 1,936,000 | 11.2 | 18.7 | 57.1 | 4.6 | 1.8 | 1.1 | 12.5 | 3,824,000 | 125.4 | 2,650,000 | 3,872,000 |
| | 1990 | 3.1 | 0.2 | 3.2 | 3.4 | 1.9 | 112,000 | 2.3 | 6.9 | 60.7 | 1.1 | 1.4 | 0.8 | 8.4 | 2,478,000 | 109.4 | (212,000) | |
| | 10 yr. Avg. | 6.7 | 4.1 | 6.8 | 8.9 | 6.6 | 1,023,100.0 | 9.2 | 15.0 | 57.0 | 3.2 | 1.8 | 1.0 | 13.1 | 2,396,900.0 | 116.4 | 1,272,600.0 | 2,163,111.1 |

## TABLE C-2

### A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION COST ESTIMATES ON THE **ABITIBI-PRICE FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -44,600.0 | 82,005.0 | 62,809.3 | -19,195.7 | -44,600.0 | -89,230.5 | -44,630.5 |
| Change in Net Income | % | - | - | - | -23.4 | - | - | 100.1 |
| Operating Income | $'000s | -19,300.0 | 131,085.9 | 24,274.0 | -106,811.9 | -19,300.0 | -126,111.9 | -106,811.9 |
| Internal Cash Flow | $'000s | 68,700.0 | 188,073.8 | 167,093.8 | -20,980.0 | 68,700.0 | -8,830.9 | -77,530.9 |
| Current Ratio | Times | 1.4 | 2.2 | 1.9 | -0.3 | 1.4 | 1.1 | -0.3 |
| Quick Ratio | Times | 0.6 | 1.2 | 1.0 | -0.2 | 0.6 | 0.5 | -0.1 |
| Interest Coverage | Times | -0.1 | 4.5 | 1.5 | -3.0 | -0.1 | -0.8 | -0.7 |
| Return on Capital Employed | % | -0.2 | 8.5 | 6.7 | -1.8 | -0.2 | -1.3 | -1.1 |
| Return on Assets | % | 0.5 | 5.8 | 5.3 | -0.5 | 0.5 | -0.7 | -1.2 |
| Return on Sales | % | -1.4 | 3.3 | 2.5 | -0.8 | -1.4 | -2.9 | -1.5 |
| EBIAT/Total Assets | % | 0.5 | 5.7 | 5.3 | -0.4 | 0.5 | -0.7 | -1.2 |
| EBIT/Total Assets | % | -0.2 | 8.5 | 6.7 | -1.8 | -0.2 | -1.3 | -1.1 |
| Cash Flow to Debt | Times | 5.2 | 17.3 | 14.8 | -2.5 | 5.2 | 2.5 | -2.7 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 12.5 | 12.5 | - | 21.0 | 21.0 |
| Total Debt to Total Assets | Times | 53.7 | 51.2 | 54.5 | 3.3 | 53.7 | 57.5 | 3.8 |
| Working Capital to Assets | Times | 7.6 | 19.7 | 15.2 | -4.5 | 7.6 | 2.7 | -4.9 |

## TABLE C-3

## A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION COST ESTIMATES ON THE **BOISE CASCADES FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1982 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | 8,638 | 160,392 | 151,409 | -8,983.0 | 87,840 | 78,857 | -8,983.0 |
| Change in Net Income | % | - | - | - | -5.6 | - | - | -10.2 |
| Operating Income | $'000s | -48,126 | 225,673 | 204,766 | -20,907.0 | 138,441 | 117,534 | -20,907.0 |
| Internal Cash Flow | $'000s | 170,292 | 406,619 | 403,571 | -3,048.0 | 399,821 | 396,774 | -3,047.0 |
| Current Ratio | Times | 1.7 | 1.5 | 1.5 | 0.0 | 1.3 | 1.3 | 0.0 |
| Quick Ratio | Times | 0.8 | 0.8 | 0.8 | 0.0 | 0.7 | 0.7 | 0.0 |
| Interest Coverage | Times | 1.0 | 3.1 | 2.8 | -0.3 | 2.0 | 1.8 | -0.2 |
| Return on Capital Employed | % | 2.6 | 6.5 | 6.3 | -0.2 | 3.6 | 3.5 | -0.1 |
| Return on Assets | % | 3.4 | 6.5 | 6.4 | -0.1 | 4.0 | 3.9 | -0.1 |
| Return on Sales | % | 0.2 | 3.4 | 3.2 | -0.2 | 1.8 | 1.6 | -0.2 |
| EBIAT/Total Assets | % | 3.4 | 6.5 | 6.4 | -0.1 | 4.0 | 3.9 | -0.1 |
| EBIT/Total Assets | % | 3.0 | 8.7 | 8.3 | -0.4 | 5.0 | 4.7 | -0.3 |
| Cash Flow to Debt | Times | 10.1 | 16.6 | 16.1 | -0.5 | 10.7 | 10.4 | -0.3 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 2.0 | 2.0 | - | 1.1 | 1.1 |
| Total Debt to Total Assets | Times | 51.1 | 56.6 | 57.3 | 0.7 | 67.1 | 67.5 | 0.4 |
| Working Capital to Assets | Times | 11.5 | 8.1 | 7.8 | -0.3 | 5.0 | 4.8 | -0.2 |

## TABLE C-4

## A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION COST ESTIMATES ON THE **CPFP FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -9,400.0 | 75,580.6 | 65,760.2 | -9,820.4 | -9,400.0 | -31,590.1 | -22,190.1 |
| Change in Net Income | % | - | - | - | -13.0 | - | - | 236.1 |
| Operating Income | $'000s | -28,200.0 | 125,918.0 | 103,727.9 | -22,190.1 | -28,200.0 | -50,390.1 | -22,190.1 |
| Internal Cash Flow | $'000s | 131,600.0 | 153,875.0 | 149,877.5 | -3,997.5 | 131,600.0 | 115,232.7 | -16,367.3 |
| Current Ratio | Times | 1.8 | 1.6 | 1.5 | -0.1 | 1.8 | 1.7 | -0.1 |
| Quick Ratio | Times | 0.7 | 0.8 | 0.7 | -0.1 | 0.7 | 0.7 | 0.0 |
| Interest Coverage | Times | 0.9 | 6.8 | 4.7 | -2.1 | 0.9 | 0.5 | -0.4 |
| Return on Capital Employed | % | 0.6 | 7.5 | 6.8 | -0.7 | 0.6 | -0.1 | -0.7 |
| Return on Assets | % | 1.0 | 6.9 | 6.5 | -0.4 | 1.0 | 0.6 | -0.4 |
| Return on Sales | % | -0.4 | 6.5 | 5.6 | -0.9 | -0.4 | -1.5 | -1.1 |
| EBIAT/Total Assets | % | 1.0 | 6.9 | 6.5 | -0.4 | 1.0 | 0.6 | -0.4 |
| EBIT/Total Assets | % | 1.2 | 10.8 | 9.3 | -1.5 | 1.2 | 0.7 | -0.5 |
| Cash Flow to Debt | Times | 8.1 | 22.0 | 19.7 | -2.3 | 8.1 | 6.8 | -1.3 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 2.2 | 2.2 | - | 6.0 | 6.0 |
| Total Debt to Total Assets | Times | 49.8 | 48.9 | 51.4 | 2.5 | 49.8 | 51.3 | 1.5 |
| Working Capital to Assets | Times | 9.6 | 9.0 | 7.9 | -1.1 | 9.6 | 8.7 | -0.9 |

## TABLE C-5

### A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION COST ESTIMATES ON THE **DOMTAR FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -294,000.0 | 46,245.6 | 34,766.6 | -11,479.0 | -294,000.0 | -328,310.5 | -34,310.5 |
| Change in Net Income | % | - | - | - | -24.8 | - | - | 11.7 |
| Operating Income | $'000s | -476,000.0 | 57,683.5 | 23,373.0 | -34,310.5 | -476,000.0 | -510,310.5 | -34,310.5 |
| Internal Cash Flow | $'000s | -259,000.0 | 159,756.2 | 163,456.1 | 3,699.9 | -259,000.0 | -278,131.7 | -19,131.7 |
| Current Ratio | Times | 1.4 | 1.9 | 1.8 | -0.1 | 1.4 | 1.3 | -0.1 |
| Quick Ratio | Times | 0.6 | 1.1 | 1.0 | -0.1 | 0.6 | 0.6 | 0.0 |
| Interest Coverage | Times | -3.5 | 2.9 | 1.6 | -1.3 | -3.5 | -3.1 | 0.4 |
| Return on Capital Employed | % | -9.9 | 3.7 | 3.4 | -0.3 | -9.9 | -10.5 | -0.6 |
| Return on Assets | % | -7.0 | 3.7 | 3.8 | 0.1 | -7.0 | -7.2 | -0.2 |
| Return on Sales | % | -12.7 | 2.1 | 1.6 | -0.5 | -12.7 | -14.2 | -1.5 |
| EBIAT/Total Assets | % | -7.0 | 3.8 | 3.9 | 0.1 | -7.0 | -7.2 | -0.2 |
| EBIT/Total Assets | % | -12.0 | 5.0 | 4.0 | -1.0 | -12.0 | -12.0 | 0.0 |
| Cash Flow to Debt | Times | -13.6 | 12.9 | 11.8 | -1.1 | -13.6 | -13.4 | 0.2 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 9.5 | 9.5 | - | N/A | 0.0 |
| Total Debt to Total Assets | Times | 67.3 | 57.1 | 60.1 | 3.0 | 67.3 | 69.9 | 2.6 |
| Working Capital to Assets | Times | 6.1 | 14.2 | 12.8 | -1.4 | 6.1 | 4.5 | -1.6 |

## TABLE C-6

## A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION COST ESTIMATES ON THE **MACMILLAN BLEODEL FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1982 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -57,300.0 | 111,830.7 | 108,966.1 | -2,864.6 | 50,800.0 | 47,935.4 | -2,864.6 |
| Change in Net Income | % | - | - | - | -2.6 | - | - | -5.6 |
| Operating Income | $'000s | -145,100.0 | 106,687.1 | -21,846.9 | -128,534.0 | 10,300.0 | -118,234.0 | -128,534.0 |
| Internal Cash Flow | $'000s | -104,600.0 | 218,202.9 | 177,909.7 | -40,293.2 | 197,100.0 | 115,567.9 | -81,532.1 |
| Current Ratio | Times | 1.5 | 1.9 | 1.6 | -0.3 | 2.1 | 1.7 | -0.4 |
| Quick Ratio | Times | 0.7 | 0.9 | 0.7 | -0.2 | 1.0 | 0.8 | -0.2 |
| Interest Coverage | Times | -0.6 | 3.0 | 1.1 | -1.9 | 1.5 | 0.2 | -1.3 |
| Return on Capital Employed | % | -2.7 | 6.7 | 6.5 | -0.2 | 3.2 | 3.1 | -0.1 |
| Return on Assets | % | -0.7 | 6.7 | 6.6 | -0.1 | 3.7 | 3.6 | -0.1 |
| Return on Sales | % | -3.1 | 4.3 | 4.2 | -0.1 | 1.7 | 1.6 | -0.1 |
| EBIAT/Total Assets | % | 1.0 | 7.2 | 8.7 | 1.5 | 3.7 | 3.2 | -0.5 |
| EBIT/Total Assets | % | -0.4 | 8.9 | 6.5 | -2.4 | 3.4 | 3.1 | -0.3 |
| Cash Flow to Debt | Times | -8.4 | 16.9 | 16.5 | -0.4 | 10.0 | 9.8 | -0.2 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 1.0 | 1.0 | - | 0.8 | 0.8 |
| Total Debt to Total Assets | Times | 57.7 | 51.1 | 51.5 | 0.4 | 55.3 | 55.6 | 0.3 |
| Working Capital to Assets | Times | 9.8 | 14.9 | 10.6 | -4.3 | 14.6 | 10.4 | -4.2 |

## TABLE C-7

### A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION COST ESTIMATES ON THE **NORANDA FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -95,000.0 | 70,059.6 | 68,444.4 | -1,615.2 | -95,000.0 | -98,775.8 | -3,775.8 |
| Change in Net Income | % | - | - | - | -2.3 | - | - | 4.0 |
| Operating Income | $'000s | -159,000.0 | 160,130.3 | 124,339.7 | -35,790.6 | -159,000.0 | -194,700.0 | -35,700.0 |
| Internal Cash Flow | $'000s | 174,000.0 | 184,731.7 | 178,937.0 | -5,794.7 | 174,000.0 | 148,009.2 | -25,990.8 |
| Current Ratio | Times | 1.3 | 1.8 | 1.7 | -0.1 | 1.3 | 1.3 | 0.0 |
| Quick Ratio | Times | 0.6 | 0.8 | 0.8 | 0.0 | 0.6 | 0.6 | 0.0 |
| Interest Coverage | Times | 0.4 | 3.1 | 2.5 | -0.6 | 0.4 | 0.3 | -0.1 |
| Return on Capital Employed | % | 1.0 | 5.1 | 5.1 | 0.0 | 1.0 | 0.9 | -0.1 |
| Return on Assets | % | 2.4 | 5.7 | 5.6 | -0.1 | 2.4 | 2.4 | 0.0 |
| Return on Sales | % | -2.1 | 2.9 | 2.8 | -0.1 | -2.1 | -2.2 | -0.1 |
| EBIAT/Total Assets | % | 2.4 | 5.9 | 5.8 | -0.1 | 2.4 | 2.4 | 0.0 |
| EBIT/Total Assets | % | 1.5 | 10.3 | 10.1 | -0.2 | 1.5 | 1.5 | 0.0 |
| Cash Flow to Debt | Times | 3.8 | 9.5 | 9.5 | 0.0 | 3.8 | 3.7 | -0.1 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 0.7 | 0.7 | - | 0.3 | 0.3 |
| Total Debt to Total Assets | Times | 77.5 | 73.0 | 73.1 | 0.1 | 77.5 | 77.6 | 0.1 |
| Working Capital to Assets | Times | 6.2 | 11.4 | 10.4 | -1.0 | 6.2 | 5.4 | -0.8 |

**TABLE C-8**

A COMPARISON OF THE IMPACT OF THE MAXIMUM REMOVAL OPTION COST ESTIMATES ON THE **ABITIBI-PRICE FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -44,600.0 | 82,005.0 | 59,074.6 | -22,930.4 | -44,600.0 | -97,454.7 | -52,854.7 |
| Change in Net Income | % | - | - | - | -28.0 | - | - | 118.5 |
| Operating Income | $'000s | -19,300.0 | 131,085.9 | 14,860.7 | -116,225.2 | -19,300.0 | -135,525.2 | -116,225.2 |
| Internal Cash Flow | $'000s | 68,700.0 | 188,073.8 | 159,527.7 | -28,546.1 | 68,700.0 | -16,396.9 | -85,096.9 |
| Current Ratio | Times | 1.4 | 2.2 | 1.9 | -0.3 | 1.4 | 1.1 | -0.3 |
| Quick Ratio | Times | 0.6 | 1.2 | 1.0 | -0.2 | 0.6 | 0.5 | -0.1 |
| Interest Coverage | Times | -0.1 | 4.5 | 1.3 | -3.2 | -0.1 | -0.9 | -0.8 |
| Return on Capital Employed | % | -0.2 | 8.5 | 6.4 | -2.1 | -0.2 | -1.5 | -1.3 |
| Return on Assets | % | 0.5 | 5.8 | 5.2 | -0.6 | 0.5 | -0.9 | -1.4 |
| Return on Sales | % | -1.4 | 3.3 | 2.3 | -1.0 | -1.4 | -3.2 | -1.8 |
| EBIAT/Total Assets | % | 0.5 | 5.7 | 5.2 | -0.5 | 0.5 | -0.9 | -1.4 |
| EBIT/Total Assets | % | -0.2 | 8.5 | 6.4 | -2.1 | -0.2 | -1.5 | -1.3 |
| Cash Flow to Debt | Times | 5.2 | 17.3 | 14.4 | -2.9 | 5.2 | 2.0 | -3.2 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 14.4 | 14.4 | - | 24.3 | 24.3 |
| Total Debt to Total Assets | Times | 53.7 | 51.2 | 55.0 | 3.8 | 53.7 | 58.1 | 4.4 |
| Working Capital to Assets | Times | 7.6 | 19.7 | 14.7 | -5.0 | 7.6 | 2.4 | -5.2 |

## TABLE C-9

### A COMPARISON OF THE IMPACT OF THE MAXIMUM REMOVAL OPTION COST ESTIMATES ON THE **BOISE CASCADES FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1982 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | 8,638 | 160,392 | 143,470.8 | -16,921.2 | 87,840 | 70,919.1 | -16,920.9 |
| Change in Net Income | % | - | - | - | -10.6 | - | - | -19.3 |
| Operating Income | $'000s | -48,126 | 225,673 | 182,231.6 | -43,441.4 | 138,441 | 94,999 | -43,442.0 |
| Internal Cash Flow | $'000s | 170,292 | 406,619 | 404,937.7 | -1,681.3 | 399,821 | 398,140.5 | -1,680.5 |
| Current Ratio | Times | 1.7 | 1.5 | 1.4 | -0.1 | 1.3 | 1.3 | 0.0 |
| Quick Ratio | Times | 0.8 | 0.8 | 0.7 | -0.1 | 0.7 | 0.7 | 0.0 |
| Interest Coverage | Times | 1.0 | 3.1 | 2.5 | -0.6 | 2.0 | 1.6 | -0.4 |
| Return on Capital Employed | % | 2.6 | 6.5 | 6.1 | -0.4 | 3.6 | 3.4 | -0.2 |
| Return on Assets | % | 3.4 | 6.5 | 6.4 | -0.1 | 4.0 | 3.9 | -0.1 |
| Return on Sales | % | 0.2 | 3.4 | 3.1 | -0.3 | 1.8 | 1.5 | -0.3 |
| EBIAT/Total Assets | % | 3.4 | 6.5 | 6.4 | -0.1 | 4.0 | 3.9 | -0.1 |
| EBIT/Total Assets | % | 3.0 | 8.7 | 7.9 | -0.8 | 5.0 | 4.4 | -0.6 |
| Cash Flow to Debt | Times | 10.1 | 16.6 | 15.6 | -1.0 | 10.7 | 10.2 | -0.5 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 5.1 | 5.1 | - | 2.8 | 2.8 |
| Total Debt to Total Assets | Times | 51.1 | 56.6 | 58.3 | 1.7 | 67.1 | 68.2 | 1.1 |
| Working Capital to Assets | Times | 11.5 | 8.1 | 7.4 | -0.7 | 5.0 | 4.5 | -0.5 |

## TABLE C-10

A COMPARISON OF THE IMPACT OF THE MAXIMUM REMOVAL OPTION COST ESTIMATES ON THE **CPFP FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -9,400.0 | 75,580.6 | 49,957.3 | -25,623.3 | -9,400.0 | -79,086.8 | -69,686.8 |
| Change in Net Income | % | - | - | - | -33.9 | - | - | 741.4 |
| Operating Income | $'000s | -28,200.0 | 125,918.0 | 56,231.2 | -69,686.8 | -28,200.0 | -97,886.8 | -69,686.8 |
| Internal Cash Flow | $'000s | 131,600.0 | 153,875.0 | 155,233.0 | 1,358.0 | 131,600.0 | 88,894.5 | -42,705.5 |
| Current Ratio | Times | 1.8 | 1.6 | 1.4 | -0.2 | 1.8 | 1.5 | -0.3 |
| Quick Ratio | Times | 0.7 | 0.8 | 0.7 | -0.1 | 0.7 | 0.6 | -0.1 |
| Interest Coverage | Times | 0.9 | 6.8 | 2.1 | -4.7 | 0.9 | 0.0 | -0.9 |
| Return on Capital Employed | % | 0.6 | 7.5 | 5.9 | -1.6 | 0.6 | -1.1 | -1.7 |
| Return on Assets | % | 1.0 | 6.9 | 6.3 | -0.6 | 1.0 | -0.1 | -1.1 |
| Return on Sales | % | -0.4 | 6.5 | 4.3 | -2.2 | -0.4 | -3.7 | -3.3 |
| EBIAT/Total Assets | % | 1.0 | 6.9 | 6.3 | -0.6 | 1.0 | -0.1 | -1.1 |
| EBIT/Total Assets | % | 1.2 | 10.8 | 7.0 | -3.8 | 1.2 | 0.1 | -1.1 |
| Cash Flow to Debt | Times | 8.1 | 22.0 | 16.0 | -6.0 | 8.1 | 4.6 | -3.5 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 10.1 | 10.1 | - | 28.0 | 28.0 |
| Total Debt to Total Assets | Times | 49.8 | 48.9 | 57.9 | 9.0 | 49.8 | 55.3 | 5.5 |
| Working Capital to Assets | Times | 9.6 | 9.0 | 5.8 | -3.2 | 9.6 | 6.7 | -2.9 |

**TABLE C-11**

A COMPARISON OF THE IMPACT OF THE MAXIMUM REMOVAL OPTION COST ESTIMATES ON THE **DOMTAR FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -294,000.0 | 46,245.6 | 36,133.9 | -10,111.7 | -294,000.0 | -325,802.5 | -31,802.5 |
| Change in Net Income | % | - | - | - | -21.9 | - | - | 10.8 |
| Operating Income | $'000s | -476,000.0 | 57,683.5 | 25,881.0 | -31,802.5 | -476,000.0 | -507,802.5 | -31,802.5 |
| Internal Cash Flow | $'000s | -259,000.0 | 159,756.2 | 164,594.1 | 4,837.9 | -259,000.0 | -275,852.9 | -16,852.9 |
| Current Ratio | Times | 1.4 | 1.9 | 1.8 | -0.1 | 1.4 | 1.3 | -0.1 |
| Quick Ratio | Times | 0.6 | 1.1 | 1.0 | -0.1 | 0.6 | 0.6 | 0.0 |
| Interest Coverage | Times | -3.5 | 2.9 | 1.7 | -1.2 | -3.5 | -3.1 | 0.4 |
| Return on Capital Employed | % | -9.9 | 3.7 | 3.5 | -0.2 | -9.9 | -10.4 | -0.5 |
| Return on Assets | % | -7.0 | 3.7 | 3.8 | 0.1 | -7.0 | -7.1 | -0.1 |
| Return on Sales | % | -12.7 | 2.1 | 1.7 | -0.4 | -12.7 | -14.1 | -1.4 |
| EBIAT/Total Assets | % | -7.0 | 3.8 | 3.9 | 0.1 | -7.0 | -7.1 | -0.1 |
| EBIT/Total Assets | % | -12.0 | 5.0 | 4.1 | -0.9 | -12.0 | -11.9 | 0.1 |
| Cash Flow to Debt | Times | -13.6 | 12.9 | 11.9 | -1.0 | -13.6 | -13.3 | 0.3 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 9.3 | 9.3 | - | N/A | 0.0 |
| Total Debt to Total Assets | Times | 67.3 | 57.1 | 60.0 | 2.9 | 67.3 | 69.8 | 2.5 |
| Working Capital to Assets | Times | 6.1 | 14.2 | 12.8 | -1.4 | 6.1 | 4.6 | -1.5 |

## TABLE C-12

A COMPARISON OF THE IMPACT OF THE MAXIMUM REMOVAL OPTION
COST ESTIMATES ON THE **MACMILLAN BLOEDEL FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1982 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -57,300.0 | 111,830.7 | 108,520.4 | -3,310.3 | 50,800.0 | 47,489.7 | -3,310.3 |
| Change in Net Income | % | - | - | - | -3.0 | - | - | -6.5 |
| Operating Income | $'000s | -145,100.0 | 106,687.1 | -22,848.5 | -129,535.6 | 10,300.0 | -119,235.6 | -129,535.6 |
| Internal Cash Flow | $'000s | -104,600.0 | 218,202.9 | 177,174.4 | -41,028.5 | 197,100.0 | 114,832.6 | -82,267.4 |
| Current Ratio | Times | 1.5 | 1.9 | 1.6 | -0.3 | 2.1 | 1.7 | -0.4 |
| Quick Ratio | Times | 0.7 | 0.9 | 0.7 | -0.2 | 1.0 | 0.8 | -0.2 |
| Interest Coverage | Times | -0.6 | 3.0 | 1.1 | -1.9 | 1.5 | 0.2 | -1.3 |
| Return on Capital Employed | % | -2.7 | 6.7 | 6.5 | -0.2 | 3.2 | 3.1 | -0.1 |
| Return on Assets | % | -0.7 | 6.7 | 6.6 | -0.1 | 3.7 | 3.6 | -0.1 |
| Return on Sales | % | -3.1 | 4.3 | 4.2 | -0.1 | 1.7 | 1.6 | -0.1 |
| EBIAT/Total Assets | % | 1.0 | 7.2 | 7.1 | -0.1 | 3.7 | 3.6 | -0.1 |
| EBIT/Total Assets | % | -0.4 | 8.9 | 8.6 | -0.3 | 3.4 | 3.2 | -0.2 |
| Cash Flow to Debt | Times | -8.4 | 16.9 | 16.5 | -0.4 | 10.0 | 9.8 | -0.2 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 1.4 | 1.4 | - | 1.0 | 1.0 |
| Total Debt to Total Assets | Times | 57.7 | 51.1 | 51.6 | 0.5 | 55.3 | 55.6 | 0.3 |
| Working Capital to Assets | Times | 9.8 | 14.9 | 10.6 | -4.3 | 14.6 | 10.4 | -4.2 |

**TABLE C-13**

A COMPARISON OF THE IMPACT OF THE MAXIMUM REMOVAL OPTION
COST ESTIMATES ON THE **NORANDA FIRM LEVEL HISTORICAL PERFORMANCE**

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -95,000.0 | 70,059.6 | 68,444.4 | -1,615.2 | -95,000.0 | -98,775.8 | -3,775.8 |
| Change in Net Income | % | - | - | - | -2.3 | - | - | 4.0 |
| Operating Income | $'000s | -159,000.0 | 160,130.3 | 124,339.7 | -35,790.6 | -159,000.0 | -194,700.0 | -35,700.0 |
| Internal Cash Flow | $'000s | 174,000.0 | 184,731.7 | 178,937.0 | -5,794.7 | 174,000.0 | 148,009.2 | -25,990.8 |
| Current Ratio | Times | 1.3 | 1.8 | 1.7 | -0.1 | 1.3 | 1.3 | 0.0 |
| Quick Ratio | Times | 0.6 | 0.8 | 0.8 | 0.0 | 0.6 | 0.6 | 0.0 |
| Interest Coverage | Times | 0.4 | 3.1 | 2.5 | -0.6 | 0.4 | 0.3 | -0.1 |
| Return on Capital Employed | % | 1.0 | 5.1 | 5.1 | 0.0 | 1.0 | 0.9 | -0.1 |
| Return on Assets | % | 2.4 | 5.7 | 5.6 | -0.1 | 2.4 | 2.4 | 0.0 |
| Return on Sales | % | -2.1 | 2.9 | 2.8 | -0.1 | -2.1 | -2.2 | -0.1 |
| EBIAT/Total Assets | % | 2.4 | 5.9 | 5.8 | -0.1 | 2.4 | 2.4 | 0.0 |
| EBIT/Total Assets | % | 1.5 | 10.3 | 10.1 | -0.2 | 1.5 | 1.5 | 0.0 |
| Cash Flow to Debt | Times | 3.8 | 9.5 | 9.5 | 0.0 | 3.8 | 3.7 | -0.1 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 0.7 | 0.7 | - | 0.3 | 0.3 |
| Total Debt to Total Assets | Times | 77.5 | 73.0 | 73.1 | 0.1 | 77.5 | 77.6 | 0.1 |
| Working Capital to Assets | Times | 6.2 | 11.4 | 10.4 | -1.0 | 6.2 | 5.4 | -0.8 |

**TABLE C-14**

A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION
COST ESTIMATES ON THE **ABITIBI-PRICE FIRM LEVEL HISTORICAL PERFORMANCE**
WITH COSTS FROM OTHER JURISDICTIONS

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -44,600.0 | 82,005.0 | 31,743.9 | -50,261.1 | -44,600.0 | -151,411.9 | -106,811.9 |
| Change in Net Income | % | - | - | - | -61.3 | - | - | 239.5 |
| Operating Income | $'000s | -19,300.0 | 131,085.9 | 24,274.0 | -106,811.9 | -19,300.0 | -126,111.9 | -106,811.9 |
| Internal Cash Flow | $'000s | 68,700.0 | 188,073.8 | 167,093.8 | -20,980.0 | 68,700.0 | -8,830.9 | -77,530.9 |
| Current Ratio | Times | 1.4 | 2.2 | 1.9 | -0.3 | 1.4 | 1.1 | -0.3 |
| Quick Ratio | Times | 0.6 | 1.2 | 1.0 | -0.2 | 0.6 | 0.5 | -0.1 |
| Interest Coverage | Times | -0.1 | 4.5 | 1.5 | -3.0 | -0.1 | -0.8 | -0.7 |
| Return on Capital Employed | % | -0.2 | 8.5 | 3.9 | -4.6 | -0.2 | -4.6 | -4.4 |
| Return on Assets | % | 0.5 | 5.8 | 4.5 | -1.3 | 0.5 | -2.2 | -2.7 |
| Return on Sales | % | -1.4 | 3.3 | 1.3 | -2.0 | -1.4 | -4.9 | -3.5 |
| EBIAT/Total Assets | % | 0.5 | 5.7 | 4.5 | -1.2 | 0.5 | -2.2 | -2.7 |
| EBIT/Total Assets | % | -0.2 | 8.5 | 4.6 | -3.9 | -0.2 | -2.8 | -2.6 |
| Cash Flow to Debt | Times | 5.2 | 17.3 | 11.9 | -5.4 | 5.2 | -0.5 | -5.7 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 28.9 | 28.9 | - | 48.6 | 48.6 |
| Total Debt to Total Assets | Times | 53.7 | 51.2 | 58.6 | 7.4 | 53.7 | 62.1 | 8.4 |
| Working Capital to Assets | Times | 7.6 | 19.7 | 15.2 | -4.5 | 7.6 | 2.7 | -4.9 |

## TABLE C-15

A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION COST ESTIMATES ON THE **DOMTAR FIRM LEVEL HISTORICAL PERFORMANCE** WITH COSTS FROM OTHER JURISDICTIONS

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -294,000.0 | 46,245.6 | -29,850.0 | -76,095.6 | -294,000.0 | -397,971.4 | -103,971.4 |
| Change in Net Income | % | - | - | - | -164.6 | - | - | 35.4 |
| Operating Income | $'000s | -476,000.0 | 57,683.5 | -46,287.9 | -103,971.4 | -476,000.0 | -579,971.4 | -103,971.4 |
| Internal Cash Flow | $'000s | -259,000.0 | 159,756.2 | 129.652.2 | -30,104.0 | -259,000.0 | -316,979.8 | -57,979.8 |
| Current Ratio | Times | 1.4 | 1.9 | 1.5 | -0.4 | 1.4 | 1.1 | -0.3 |
| Quick Ratio | Times | 0.6 | 1.1 | 0.9 | -0.2 | 0.6 | 0.5 | -0.1 |
| Interest Coverage | Times | -3.5 | 2.9 | 0.6 | -2.3 | -3.5 | -2.5 | 1.0 |
| Return on Capital Employed | % | -9.9 | 3.7 | 1.1 | -2.6 | -9.9 | -11.5 | -1.6 |
| Return on Assets | % | -7.0 | 3.7 | 2.3 | -1.4 | -7.0 | -7.6 | -0.6 |
| Return on Sales | % | -12.7 | 2.1 | -1.4 | -3.5 | -12.7 | -17.2 | -4.5 |
| EBIAT/Total Assets | % | -7.0 | 3.8 | 2.4 | -1.4 | -7.0 | -7.6 | -0.6 |
| EBIT/Total Assets | % | -12.0 | 5.0 | 2.3 | -2.7 | -12.0 | -12.0 | 0.0 |
| Cash Flow to Debt | Times | -13.6 | 12.9 | 7.5 | -5.4 | -13.6 | -13.1 | 0.5 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 28.7 | 28.7 | - | N/A | 0.0 |
| Total Debt to Total Assets | Times | 67.3 | 57.1 | 66.9 | 9.8 | 67.3 | 74.7 | 7.4 |
| Working Capital to Assets | Times | 6.1 | 14.2 | 8.6 | -5.6 | 6.1 | 1.8 | -4.3 |

**TABLE C-16**

A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION
COST ESTIMATES ON THE **MACMILLAN BLOEDEL FIRM LEVEL HISTORICAL PERFORMANCE**
WITH COSTS FROM OTHER JURISDICTIONS

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1982 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -57,300.0 | 111,830.7 | 40,095.6 | -71,735.1 | 50,800.0 | -62,174.0 | -112,974.0 |
| Change in Net Income | % | - | - | - | -64.2 | - | - | -222.4 |
| Operating Income | $'000s | -145,100.0 | 106,687.1 | -21,846.9 | -128,534.0 | 10,300.0 | -118,234.0 | -128,534.0 |
| Internal Cash Flow | $'000s | -104,600.0 | 218,202.9 | 177,909.7 | -40,293.2 | 197,100.0 | 115,567.9 | -81,532.1 |
| Current Ratio | Times | 1.5 | 1.9 | 1.6 | -0.3 | 2.1 | 1.7 | -0.4 |
| Quick Ratio | Times | 0.7 | 0.9 | 0.7 | -0.2 | 1.0 | 0.8 | -0.2 |
| Interest Coverage | Times | -0.6 | 3.0 | 1.1 | -1.9 | 1.5 | 0.2 | -1.3 |
| Return on Capital Employed | % | -2.7 | 6.7 | 4.0 | -2.7 | 3.2 | 0.3 | -2.9 |
| Return on Assets | % | -0.7 | 6.7 | 4.8 | -1.9 | 3.7 | 1.5 | -2.2 |
| Return on Sales | % | -3.1 | 4.3 | 1.6 | -2.7 | 1.7 | -2.1 | -3.8 |
| EBIAT/Total Assets | % | 1.0 | 7.2 | 5.2 | -2.0 | 3.7 | 1.5 | -2.2 |
| EBIT/Total Assets | % | -0.4 | 8.9 | 4.8 | -4.1 | 3.4 | 0.8 | -2.6 |
| Cash Flow to Debt | Times | -8.4 | 16.9 | 10.8 | -6.1 | 10.0 | 4.9 | -5.1 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 22.6 | 22.6 | - | 15.2 | 15.2 |
| Total Debt to Total Assets | Times | 57.7 | 51.1 | 58.6 | 7.5 | 55.3 | 61.5 | 6.2 |
| Working Capital to Assets | Times | 9.8 | 14.9 | 10.6 | -4.3 | 14.6 | 10.4 | -4.2 |

## TABLE C-17

A COMPARISON OF THE IMPACT OF THE MOST COST-EFFECTIVE OPTION COST ESTIMATES ON THE **NORANDA FIRM LEVEL HISTORICAL PERFORMANCE** WITH COSTS FROM OTHER JURISDICTIONS

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -95,000.0 | 70,059.6 | 54,465.1 | -15,594.5 | -95,000.0 | -130,790.0 | -35,790.0 |
| Change in Net Income | % | - | - | - | -22.3 | - | - | 37.7 |
| Operating Income | $'000s | -159,000.0 | 160,130.3 | 124,339.7 | -35,790.6 | -159,000.0 | -194,790.6 | -35,790.6 |
| Internal Cash Flow | $'000s | 174,000.0 | 184,731.7 | 178,937.0 | -5,794.7 | 174,000.0 | 148,009.2 | -25,990.8 |
| Current Ratio | Times | 1.3 | 1.8 | 1.7 | -0.1 | 1.3 | 1.3 | 0.0 |
| Quick Ratio | Times | 0.6 | 0.8 | 0.8 | 0.0 | 0.6 | 0.6 | 0.0 |
| Interest Coverage | Times | 0.4 | 3.1 | 2.5 | -0.6 | 0.4 | 0.3 | -0.1 |
| Return on Capital Employed | % | 1.0 | 5.1 | 4.6 | -0.5 | 1.0 | 0.4 | -0.6 |
| Return on Assets | % | 2.4 | 5.7 | 5.3 | -0.4 | 2.4 | 2.0 | -0.4 |
| Return on Sales | % | -2.1 | 2.9 | 2.2 | -0.7 | -2.1 | -2.9 | -0.8 |
| EBIAT/Total Assets | % | 2.4 | 5.9 | 5.5 | -0.4 | 2.4 | 2.0 | -0.4 |
| EBIT/Total Assets | % | 1.5 | 10.3 | 9.1 | -1.2 | 1.5 | 1.1 | -0.4 |
| Cash Flow to Debt | Times | 3.8 | 9.5 | 8.8 | -0.7 | 3.8 | 3.1 | -0.7 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 6.3 | 6.3 | - | 3.0 | 3.0 |
| Total Debt to Total Assets | Times | 77.5 | 73.0 | 74.4 | 1.4 | 77.5 | 78.5 | 1.0 |
| Working Capital to Assets | Times | 6.2 | 11.4 | 10.4 | -1.0 | 6.2 | 5.4 | -0.8 |

TABLE C-18

A COMPARISON OF THE IMPACT OF THE MAXIMUM REMOVAL OPTION
COST ESTIMATES ON THE **ABITIBI-PRICE FIRM LEVEL HISTORICAL PERFORMANCE**
WITH COSTS FROM OTHER JURISDICTIONS

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -44,600.0 | 82,005.0 | 22,330.7 | -59,674.3 | -44,600.0 | -160,825.2 | -116,225.2 |
| Change in Net Income | % | - | - | - | -72.8 | - | - | 260.6 |
| Operating Income | $'000s | -19,300.0 | 131,085.9 | 14,860.7 | -116,225.2 | -19,300.0 | -135,525.2 | -116,225.2 |
| Internal Cash Flow | $'000s | 68,700.0 | 188,073.8 | 159,527.7 | -28,546.1 | 68,700.0 | -16,396.9 | -85,096.9 |
| Current Ratio | Times | 1.4 | 2.2 | 1.9 | -0.3 | 1.4 | 1.1 | -0.3 |
| Quick Ratio | Times | 0.6 | 1.2 | 1.0 | -0.2 | 0.6 | 0.5 | -0.1 |
| Interest Coverage | Times | -0.1 | 4.5 | 1.3 | -3.2 | -0.1 | -0.9 | -0.8 |
| Return on Capital Employed | % | -0.2 | 8.5 | 3.5 | -5.0 | -0.2 | -5.0 | -4.8 |
| Return on Assets | % | 0.5 | 5.8 | 4.2 | -1.6 | 0.5 | -2.5 | -3.0 |
| Return on Sales | % | -1.4 | 3.3 | 0.9 | -2.4 | -1.4 | -5.2 | -3.8 |
| EBIAT/Total Assets | % | 0.5 | 5.7 | 4.1 | -1.6 | 0.5 | -2.5 | -3.0 |
| EBIT/Total Assets | % | -0.2 | 8.5 | 4.2 | -4.3 | -0.2 | -3.0 | -2.8 |
| Cash Flow to Debt | Times | 5.2 | 17.3 | 11.2 | -6.1 | 5.2 | -0.9 | -6.1 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 30.7 | 30.7 | - | 51.6 | 51.6 |
| Total Debt to Total Assets | Times | 53.7 | 51.2 | 59.3 | 8.1 | 53.7 | 62.6 | 8.9 |
| Working Capital to Assets | Times | 7.6 | 19.7 | 14.7 | -5.0 | 7.6 | 2.4 | -5.2 |

## TABLE C-19

A COMPARISON OF THE IMPACT OF THE MAXIMUM REMOVAL OPTION COST ESTIMATES ON THE **DOMTAR FIRM LEVEL HISTORICAL PERFORMANCE** WITH COSTS FROM OTHER JURISDICTIONS

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -294,000.0 | 46,245.6 | -24,123.5 | -70,369.1 | -294,000.0 | -392,244.9 | -98,244.9 |
| Change in Net Income | % | - | - | - | -152.2 | - | - | 33.4 |
| Operating Income | $'000s | -476,000.0 | 57,683.5 | -40,561.4 | -98,244.9 | -476,000.0 | -574,244.9 | -98,244.9 |
| Internal Cash Flow | $'000s | -259,000.0 | 159,756.2 | 135,562.0 | -24,194.2 | -259,000.0 | -311,070.0 | -52,070.0 |
| Current Ratio | Times | 1.4 | 1.9 | 1.5 | -0.4 | 1.4 | 1.1 | -0.3 |
| Quick Ratio | Times | 0.6 | 1.1 | 0.9 | -0.2 | 0.6 | 0.5 | -0.1 |
| Interest Coverage | Times | -3.5 | 2.9 | 0.7 | -2.2 | -3.5 | -2.5 | 1.0 |
| Return on Capital Employed | % | -9.9 | 3.7 | 1.4 | -2.3 | -9.9 | -11.2 | -1.3 |
| Return on Assets | % | -7.0 | 3.7 | 2.5 | -1.2 | -7.0 | -7.4 | -0.4 |
| Return on Sales | % | -12.7 | 2.1 | -1.1 | -3.2 | -12.7 | -17.0 | -4.3 |
| EBIAT/Total Assets | % | -7.0 | 3.8 | 2.6 | -1.2 | -7.0 | -7.4 | -0.4 |
| EBIT/Total Assets | % | -12.0 | 5.0 | 2.5 | -2.5 | -12.0 | -11.8 | 0.2 |
| Cash Flow to Debt | Times | -13.6 | 12.9 | 7.9 | -5.0 | -13.6 | -12.9 | 0.7 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 28.8 | 28.8 | - | N/A | 0.0 |
| Total Debt to Total Assets | Times | 67.3 | 57.1 | 66.7 | 9.6 | 67.3 | 74.5 | 7.2 |
| Working Capital to Assets | Times | 6.1 | 14.2 | 8.9 | -5.3 | 6.1 | 1.9 | -4.2 |

## TABLE C-20

### A COMPARISON OF THE IMPACT OF THE MAXIMUM REMOVAL OPTION COST ESTIMATES ON THE **MACMILLAN BLOEDEL FIRM LEVEL HISTORICAL PERFORMANCE** WITH COSTS FROM OTHER JURISDICTIONS

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1982 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -57,300.0 | 111,830.7 | 39,094.0 | -72,736.7 | 50,800.0 | -63,175.6 | -113,975.6 |
| Change in Net Income | % | - | - | - | -65.0 | - | - | -224.4 |
| Operating Income | $'000s | -145,100.0 | 106,687.1 | -22,848.5 | -129,535.6 | 10,300.0 | -119,235.6 | -129,535.6 |
| Internal Cash Flow | $'000s | -104,600.0 | 218,202.9 | 177,174.4 | -41,028.5 | 197,100.0 | 114,832.6 | -82,267.4 |
| Current Ratio | Times | 1.5 | 1.9 | 1.6 | -0.3 | 2.1 | 1.7 | -0.4 |
| Quick Ratio | Times | 0.7 | 0.9 | 0.7 | -0.2 | 1.0 | 0.8 | -0.2 |
| Interest Coverage | Times | -0.6 | 3.0 | 1.1 | -1.9 | 1.5 | 0.2 | -1.3 |
| Return on Capital Employed | % | -2.7 | 6.7 | 3.9 | -2.8 | 3.2 | 0.3 | -2.9 |
| Return on Assets | % | -0.7 | 6.7 | 4.7 | -2.0 | 3.7 | 1.4 | -2.3 |
| Return on Sales | % | -3.1 | 4.3 | 1.5 | -2.8 | 1.7 | -2.1 | -3.8 |
| EBIAT/Total Assets | % | 1.0 | 7.2 | 5.2 | -2.0 | 3.7 | 1.4 | -2.3 |
| EBIT/Total Assets | % | -0.4 | 8.9 | 4.7 | -4.2 | 3.4 | 0.7 | -2.7 |
| Cash Flow to Debt | Times | -8.4 | 16.9 | 10.7 | -6.2 | 10.0 | 4.8 | -5.2 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 22.8 | 22.8 | - | 15.3 | 15.3 |
| Total Debt to Total Assets | Times | 57.7 | 51.1 | 58.6 | 7.5 | 55.3 | 61.6 | 6.3 |
| Working Capital to Assets | Times | 9.8 | 14.9 | 10.6 | -4.3 | 14.6 | 10.4 | -4.2 |

## TABLE C-21

### A COMPARISON OF THE IMPACT OF THE MAXIMUM REMOVAL OPTION COST ESTIMATES ON THE **NORANDA FIRM LEVEL HISTORICAL PERFORMANCE** WITH COSTS FROM OTHER JURISDICTIONS

| Financial Indicators | Units of Financial Indicators | Worst Year (Lowest Operating Income) 1990 | TEN YEAR AVERAGE | | | 1990 | | |
|---|---|---|---|---|---|---|---|---|
| | | | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change | Financial Indicators Before Regulatory Costs | Financial Indicators After Regulatory Costs | Change |
| Net Income | $'000s | -95,000.0 | 70,059.6 | 54,465.1 | -15,594.5 | -95,000.0 | -130,790.0 | -35,790.0 |
| Change in Net Income | % | - | - | - | -22.3 | - | - | 37.7 |
| Operating Income | $'000s | -159,000.0 | 160,130.3 | 124,339.7 | -35,790.6 | -159,000.0 | -194,790.6 | -35,790.6 |
| Internal Cash Flow | $'000s | 174,000.0 | 184,731.7 | 178,937.0 | -5,794.7 | 174,000.0 | 148,009.2 | -25,990.8 |
| Current Ratio | Times | 1.3 | 1.8 | 1.7 | -0.1 | 1.3 | 1.3 | 0.0 |
| Quick Ratio | Times | 0.6 | 0.8 | 0.8 | 0.0 | 0.6 | 0.6 | 0.0 |
| Interest Coverage | Times | 0.4 | 3.1 | 2.5 | -0.6 | 0.4 | 0.3 | -0.1 |
| Return on Capital Employed | % | 1.0 | 5.1 | 4.6 | -0.5 | 1.0 | 0.4 | -0.6 |
| Return on Assets | % | 2.4 | 5.7 | 5.3 | -0.4 | 2.4 | 2.0 | -0.4 |
| Return on Sales | % | -2.1 | 2.9 | 2.2 | -0.7 | -2.1 | -2.9 | -0.8 |
| EBIAT/Total Assets | % | 2.4 | 5.9 | 5.5 | -0.4 | 2.4 | 2.0 | -0.4 |
| EBIT/Total Assets | % | 1.5 | 10.3 | 9.1 | -1.2 | 1.5 | 1.1 | -0.4 |
| Cash Flow to Debt | Times | 3.8 | 9.5 | 8.8 | -0.7 | 3.8 | 3.1 | -0.7 |
| MISA Capital Costs/Capital Expenditures | % | - | - | 6.3 | 6.3 | - | 3.0 | 3.0 |
| Total Debt to Total Assets | Times | 77.5 | 73.0 | 74.4 | 1.4 | 77.5 | 78.5 | 1.0 |
| Working Capital to Assets | Times | 6.2 | 11.4 | 10.4 | -1.0 | 6.2 | 5.4 | -0.8 |